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in brief

COVER BY RALPH BUTLER

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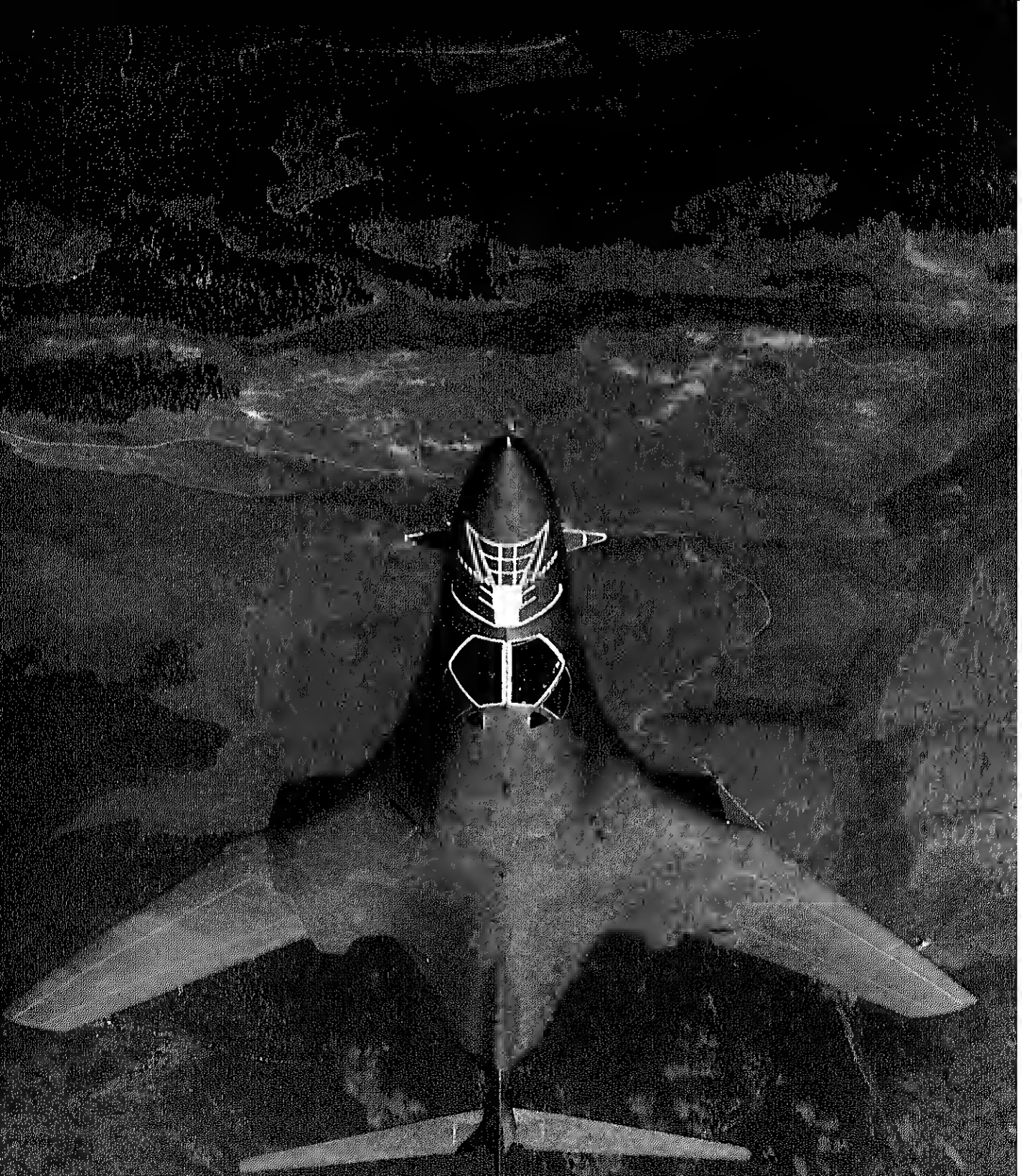


Defense program instability: causes, costs, and cures

By JACQUES S. GANSLER

As federal deficit reduction initiatives gain momentum, pressure is mounting to improve efficiency and effectiveness in DoD. The department and Congress can achieve major gains in this area by eliminating instability in weapon system acquisition programs—an especially difficult challenge in the environment of Gramm-Rudman-Hollings.

Undoubtedly the best known—and most troublesome—of defense acquisition trends are the large cost growth, or "overrun," and schedule slippage which occur on the typical program. Numerous studies done by the U.S. General Accounting Office and others have shown that the cost of the average defense program grows by 50 percent to 100 percent during its lifetime, depending upon how inflation is accounted for. This cost growth is generally accompanied by an average program delivery slippage of about 30 percent.

Cost growth and program stretchout are strongly interrelated and tend to reinforce one another. As increasing costs hit against a fixed or decreasing budget, the only way to "fit" higher program costs within the budget is to stretch out the program by either extending development or buying fewer production units each year. Unfortunately, this stretchout causes significant program inefficiencies, thus driving costs even higher, which in turn causes still further stretchouts, and so forth.

The critical question is: What causes these program cost growths and schedule delays? Common belief lays the blame on unforeseen technical problems and the government's inability to accurately estimate likely development and production costs. However, numerous recent studies—many by the Defense Department itself and others by independent research organizations—have indicated otherwise. They show that, at least as of late, the principal cause of cost growth and schedule slippage has been instability in establishing requirements, planning, and budgeting for weapon systems.

One of the more significant studies leading to this conclusion was a 1983 effort on the part of the Air Force Systems Command.[1] In it, analysts reviewed more than 100 weapon system programs covering the last 30 years of Air Force acquisitions. The study group then did detailed case studies on 55 of these programs; some had gone into full-scale development before 1970, and others entered this phase after 1970 (see Figure 1, p. 4). The study group looked at all of these programs in an effort to identify the major factors affecting cost and schedule growth in each; the data in Figure 2 (p. 4) summarize their conclusions. As can be seen from this figure, the commonly held assumption that program problems are primarily technically based was, in fact, true in the past.

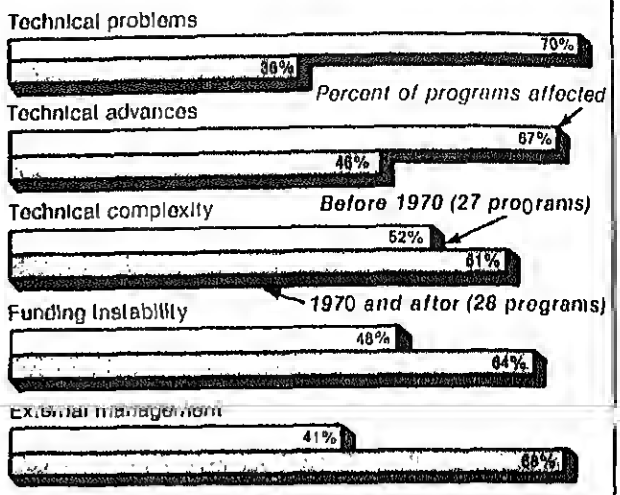
More recently, however, other causes of cost and schedule growth in Air Force weapon systems have come to dominate. These have largely been external and nontechnical and tend to derive from two sources—external management impacts and funding instability. The former comprises nonbudgetary changes external to the

The B-1B exemplifies a stable procurement program, largely because the Air Force applied a concept known as baselining. Other

Figure 1. The 55 weapon system acquisitions studied in depth by the Air Force Systems Command in 1983

Before 1970		*1970 and after*	
AIRCRAFT		**AIRCRAFT**	
F-100	F-111	F-15	A-10
F-101	B-52	F-16	B-1
F-102	B-58		
F-104	C-130		
F-105	C-141		
F-106	C-5A		
ARMAMENT		**ARMAMENT**	
Matador		GBU-15	Firebolt
Snark		IR Maverick	AMRAAM
BOMARC		LLLGB	WASP
Hound Dog			
Sparrow (AIM-7F)			
SRAM			
TV Maverick			
SPACE & MISSILES		**SPACE & MISSILES**	
DSCS II		DSCS III	GPS
DMSP 5A		NATO III	IUS
Burner II		DMSP 5D-1	MX
Titan II		DMSP 5D-2	
Minuteman I			
COMMAND, CONTROL & COMMUNICATIONS		**COMMAND, CONTROL & COMMUNICATIONS**	
SAGE		PAVE PAWS	
BMEWS		OTH-B	
AN/FPS-85		AWACS	
		CHEY MTN IMP	
		E-4B	
		Oasis	
		TACC AUTO	
		JTIDS	
		Seek Talk	
		AFSATCOM RCVR	
		AN/ARC-164	

Figure 2. Major factors affecting cost and schedule growth on the 55 Air Force programs



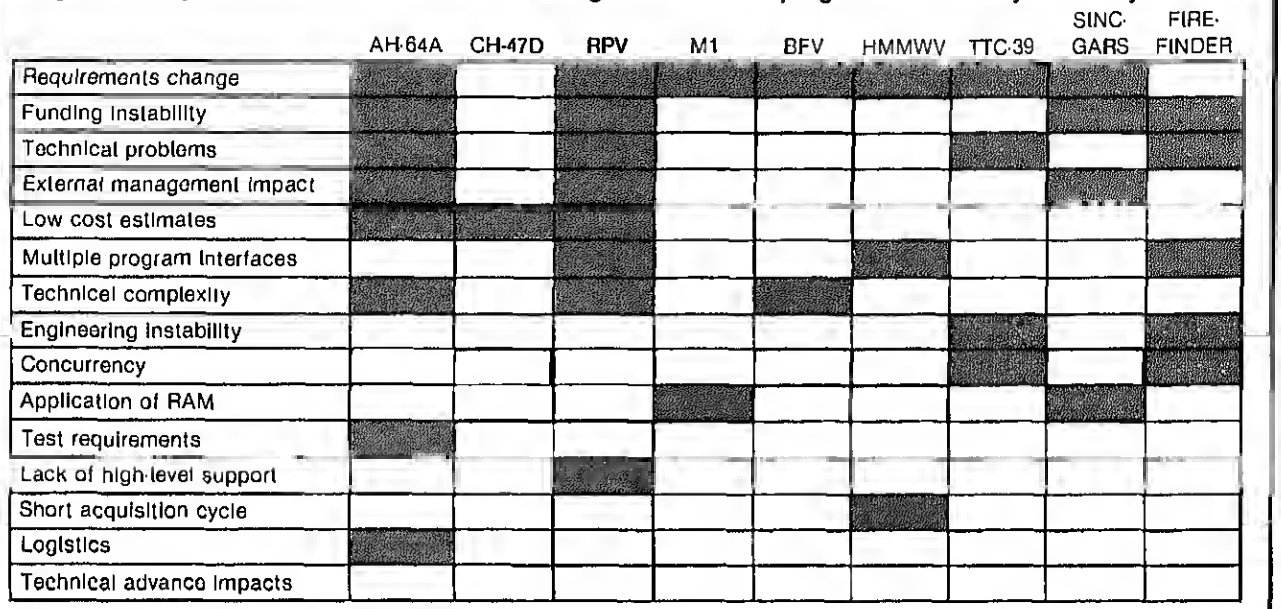
program such as changes in service requirements relating to quantity and performance, decisions to incorporate new technology, and reactions to newly discovered threats. The latter source, funding instability, is the result of frequent budgetary changes to a program coming from various offices within the service itself, the office of the secretary of defense, the Office of Management and Budget, and the Congress. Again, of course, these two areas are strongly interrelated.

The emergence of management impacts and funding instability as major causes of cost and schedule growth is not unique to the Air Force. In 1985, the Army Materiel Command did a similar study of cost and schedule growth factors in nine Army programs.[2] As shown by the data in Figure 3, changes in requirements were, overwhelmingly, the principal cause of cost and schedule growth for these weapon systems; funding instability was important as well, and technical problems remained significant too. Thus, the Army data confirm the findings of the prior Air Force study and, albeit for a smaller statistical sample, indicate an even greater degree of impact from requirements changes. The data in Figure 4 (p. 6), for example, clearly show the effect of dramatic changes from year to year in the quantity of systems ordered. As would be expected, the funding available for a program, the quantities ordered, and the rising unit costs (in part attributable to the reduced quantities) are strongly interrelated, and determining which is the cause and which the effect can be very hard to do.

What is the overall effect of instability on the planning and budgeting process? The following scenario is common. After receiving guidance from the president and the secretary of defense, the service initially assumes that a certain total number of dollars will be available to procure a certain quantity of various weapon systems. Then, typically, first the president and later the Congress reduce the total obligational authority. In order to maintain the efficiency of the programs affected, the proper way of taking such an overall budget cut is to prioritize programs and then defer or cancel enough lower-priority programs to absorb the reduced dollars. Historically, however, this has not happened because both the Defense Department and Congress have been reluctant to cancel programs.

Instead, the approach has been to simply buy fewer of each system in the current year and buy the rest in later years, thereby stretching out all of the programs. The con-

Figure 3. Major causes of cost and schedule growth on nine programs studied by the Army in 1985



NOTE: THESE FINDINGS CONFIRMED BY PROGRAM OFFICES

smaller, their unit costs rise. (The manufacturer is building the equipment at a less efficient rate, and, in addition, a smaller number of units is absorbing all of the fixed plant and equipment as well as management costs.) This begins the spiraling of costs. Since unit costs have increased, the service is able to buy still fewer systems than the reduced obligational authority would have allowed. Even if the programs themselves are otherwise perfectly managed, the quantities of systems procured will be significantly less.

But as history has shown, program costs within DoD tend to grow too (for reasons discussed below) and thus, if unit costs in each program grow and total dollars are fixed, the quantity of each system that can be procured shrinks once more. As a result, annual production rates decline still further, and unit costs increase correspondingly, resulting in yet another cutback in quantities procured. The effect on our fighting forces is clear—they get fewer systems and they get them later. This phenomenon is well-documented and generally accepted as a necessary fact of weapon system procurement. What is neither as well-known, nor as well-accepted, is that in the absence of this instability, we could get a lot more equipment for the same dollars!

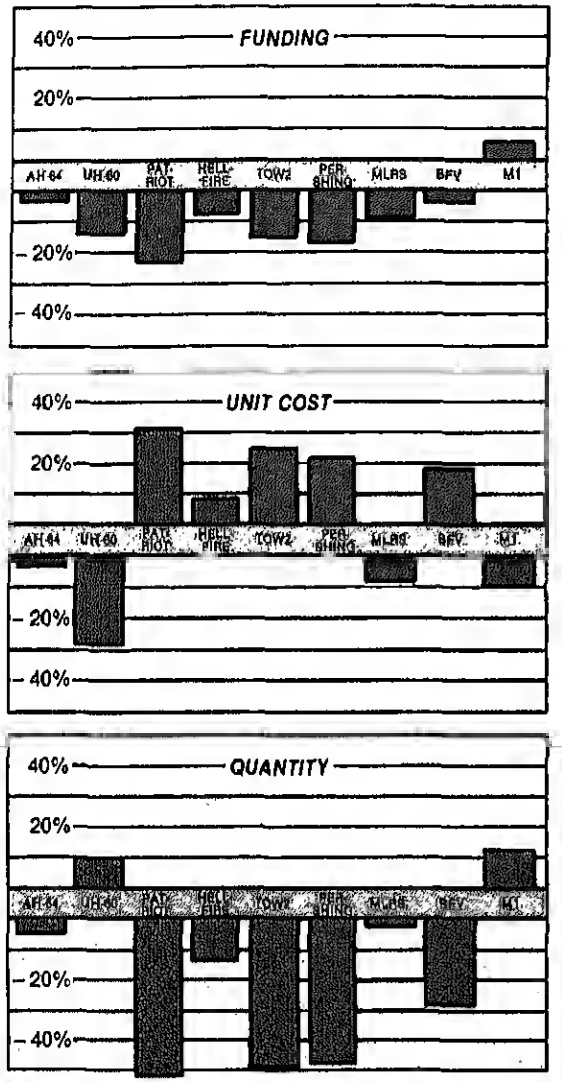
To demonstrate this, consider two examples, one program each from the Air Force and Army analyses. As shown in Figure 5 (p. 7), the Air Force originally planned an annual production rate in the range of 150 aircraft per

use of factory capacity, throughout most of the production run. But due largely to program cost growth from the bottom up and a reduction in total procurement dollars available from the top down, the Air Force decided to stretch out the program by approximately three years and to produce at significantly lower rates—an average of less than 100 per year—during much of this time. Independent analyses done by the aircraft producer and the Air Force both showed that, assuming all other considerations held constant, the cost of the three-year stretchout and the reduced production rates was approximately $2 billion (excluding the effects of inflation on the stretched-out program).

This amount, one should note, equals the procurement cost of approximately 83 F-15 aircraft. In other words, the nation lost more than a wing of aircraft as a result of increased unit costs caused by the production stretchout. Yet many still insist that by buying less each year, DoD is simply stretching out a program and procuring the same total number of aircraft over a longer period of time. The reality, as this example illustrates, is that the department actually bought fewer systems than it could have acquired for the same amount of dollars.

A second example is the Army's Patriot missile program. Once again, the data in Figure 5 show lower-than-planned average production rates for both the missiles and the fire units on this program, or stretchouts of two and three years, respectively, for the same quantities of sys-

Figure 4. The interrelationship between the funding available for the nine Army programs, the quantities ordered, and the unit costs from one year to the next.



▲ Change from FY84 budget estimate to FY85 actual

proximately $1 billion. If the original schedules had been maintained, the nation could have bought 1,760 additional Patriot missiles for the same original dollars. And indeed the Army did later decide that it needed to procure this additional number, for which it will have to pay approximately one billion dollars! Had the program remained stable, the taxpayer could have been saved a very significant amount of money.

While these two examples of program instability and *ble programs, as one would expect, have tended to experience* little cost growth. The Navy's submarine ballistic missile system, for example, has for many years been a model of a well-executed program. The service established schedules and budgets for the program years in advance and has maintained them. As a result, average cost growth, unlike the 50 percent to 100 percent of the typical defense program, has been about six percent. The Army's AH-64 Apache helicopter program is another case in point. The service has maintained its production schedule for the first 446 units and, in constant dollars, will actually *underrun its production cost estimate. These programs* prove that DoD can run stable programs. What we must do, therefore, is look in more detail at the causes of the instability and then consider possible corrective actions to reduce or eliminate it.

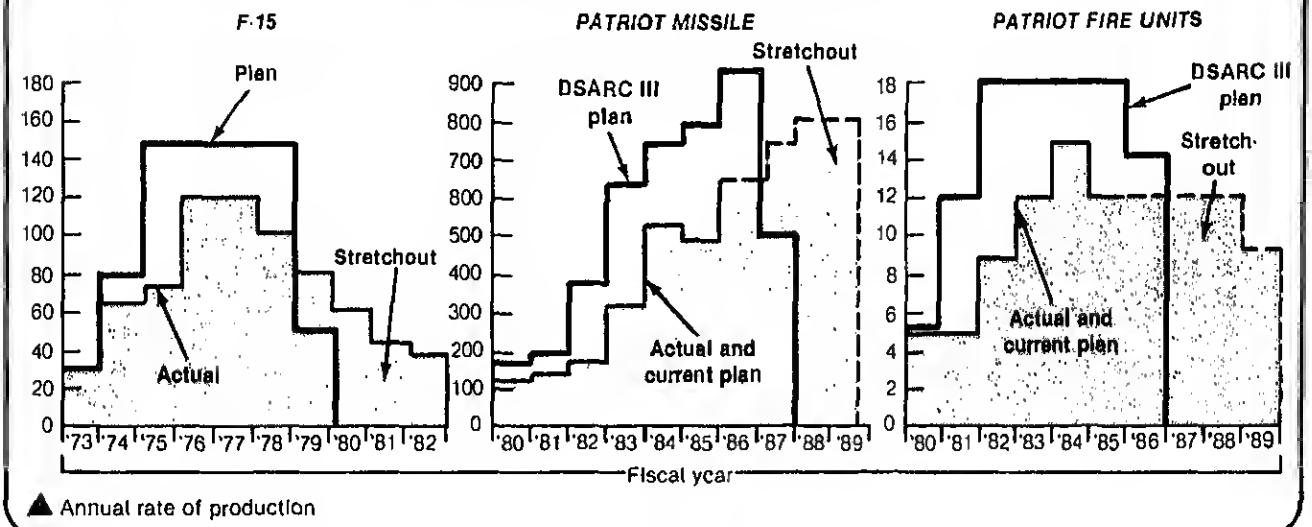
The causes of program stretchout are both external, or top down, and internal, or bottom up. Whether external or internal, they are major acquisition management issues, not procurement issues per se. As noted above, the impacts from budget changes and the effects of requirements changes are obviously interrelated. But the agents of change in the two areas are different. In the first, budgetary matters, Congress introduces some and the executive branch introduces others.

Clearly, Congress determines the overall fiscal environment, beginning with its insistence upon a one-year defense budget. The United States is the only nation in the world that operates with a one-year defense budget; most countries have a three- to five-year commitment. Thus, annual revisions are almost a given. In the past, however, only a very few congressional committees—primarily appropriations and armed services—took part in defense reviews, and these tended to have considerable stability in their decision-making. Today, by contrast, more than 96 committees and subcommittees summon witnesses to testify on defense programs; this number represents a 357-percent increase in the last 13 years alone. In connection with fiscal year 1984 budget requests, DoD had to furnish 1,306 witnesses, who provided 2,160 hours of testimony. In addition, the department responded to approximately 85,000 written congressional inquiries and submitted 21,753 pages of supporting documents to justify the budget, an increase of more than 300 percent in the last 13 years.[3]

Not only has the number of committees and subcommittees involved in the annual defense review process increased, but congressional staff, who delve into every de-

[3] *Vincent Puritano, "The Budget Process in the Department of*

Figure 5. The effect of program stretchout on quantities procured for the Air Force's F-15 aircraft and the Army's Patriot missile



tail of the defense budget, has proliferated as well. One indication of this growth is that the number of senate office buildings has tripled since 1959, while the number of senators has remained the same.

What happens when Congress examines every detail of the defense budget? In FY 1984, legislators changed more than 700 line items in the defense appropriations bill and more than 1,000 line items in the authorization bill.[4] The net effect of all this oversight is not only instability and uncertainty but, far worse, the inefficiencies and reduced effectiveness that taxpayers get for their dollars. Clearly, the corrective action needed is greater self-discipline on the part of Congress. The first step undoubtedly should be a multiyear defense budget; specifically, a biennial budget process is most likely to win approval. Lawmakers have presented numerous bills over the last year or two to effect such a changeover, and many in Congress recognize the need.

However, while Congress sets the tone and has proven extremely disruptive to the defense budget process, responsibility for the Defense Department's budgetary woes belongs to others too. A cynic might claim, "Congress annually changes 50 percent of the defense line items, but DoD internally changes essentially 100 percent of them." The latter changes reflect a desire on the part of defense management, particularly those on the budget side, to get as much into the budget as they can each year and worry about the outyears as they come. In fact, during the course of one recent study in which proponents of greater stability were arguing for more multiyear contracting, the two-star general in charge of his service's budget process said he was quite concerned about multiyear contracts because they took away his "flexibility." Obviously, he recognized that flexibility is the inverse of stability, and you can't have both.

The typical approach in DoD is to assume that if a program can get started in the budget process it will stay in, even if it has to be done at a lower annual rate. Thus, inserting a program into the budget often requires a great deal of "initial optimism" concerning the likely cost of the total effort. With some help from unrealistically low initial estimates, a program can get its nose in the budgetary tent. This approach allows the service's overall budget to contain more programs than would otherwise be the case if the service budgeted each one realistically. For example, it may permit ten programs to be carried in a budget that might adequately fund seven. The approach also produces some very predictable results. Program costs grow not only to what would have been a realistic initial estimate, but well beyond that due to the additional funding necessary to compensate for inefficiencies caused by program instability and stretchout. The service's overall budget problem also gets worse, since this same phenomenon is simultaneously happening on all of its programs! Consequently, the services must contend with an ever-increasing "bow wave" of growing program costs.

6). Plans called for spending on them to peak at about $4.5 billion per year between 1976 and 1978. By the early 1980s, however, expenditures for these same seven programs were at much greater levels than initially projected, and deliveries had slipped considerably. The resulting bow wave depicted in the figure is fairly typical of defense programs. What is the net cumulative effect? Only a few years ago, when the annual defense budget was approximately $100 billion, DoD was saying that there was "not enough money in the budget to cover the existing programs." Today, the annual defense budget totals approximately $300 billion, and DoD still says there is "not enough money in the budget to cover the existing programs." Underfunding and stretchouts have continued on new programs added in the meantime, causing needless cost increases and quantity reductions on almost all programs.

What the defense budget process needs is an affordability constraint on the introduction of new programs. If too many projects are in full-scale development and production simultaneously, then some must wait until they efficiently fit into the total available dollars. The choice is between running fewer programs efficiently—delaying some until later years—and running all of the programs simultaneously and inefficiently. The costs for the two approaches are dramatically different, and so is the amount of military equipment actually procured.

Further compounding the problem of budget instability on weapon systems is the services' historical tendency to protect force structure in times of total dollar cutbacks. Such action typically exacerbates the instability of acquisition accounts. For example, in the year that elapsed between the Army's initial submission of its FY 1985 budget estimate and the final FY 1985 appropriation that it received, the service took a total budget cut of five percent. However, in order to maintain force structure in the face of inflation and rising costs, the Army chose to apply these budget cuts almost solely to its acquisition accounts. As a result, the procurement account suffered a 20-percent reduction (six percent of which was attributable to the Congress), and the research and development account lost 35 percent (nine percent of which came from the Congress).

tially submitted budgets. The services can absorb cuts of this magnitude, especially if few programs are terminated during the year, only through significant and across-the-board program stretchouts. Of course, as explained above, these stretchouts cause dramatic increases in the unit costs of the system and corresponding reductions in the quantities of systems ultimately procured.

What's more, the events just described took place in years when the defense budget was increasing. Any leveling-off or reduction in total dollars available to DoD would greatly aggravate the problem, especially if, as is usually the case, manpower and other force structure costs receive highest priority, thereby causing still greater swings in acquisition accounts. The obvious corrective action is more realistic planning and budgeting. In addition, both the Congress and the executive branch must accept the fact that, if significant cuts are necessary, officials must achieve them through total deferral or elimination of programs rather than by stretching out all programs. Obviously, this is a difficult step to take, but it can be done. In view of ever-increasing budget constraints, it must be done, done soon, and then institutionalized.

The second broad, top-down set of program changes affecting defense budgets is the frequent shifts in military requirements. This problem appears to stem from the absence of any real fiscal responsibility on the part of the military users. Within the services, the developers are separate from users. Consequently, the users ask for financially unconstrained requirements, which the developers do their best to supply, regardless of the costs. The separation also encourages many technologically driven requirements, that is, the developers frequently suggest requirements, so that glamorous or otherwise interesting technology developments will be funded, once again to the detriment of program costs.

Thanks to this requirements process, the Defense Department attempts to get the very best possible weapon systems that technology can offer, but their cost becomes so high that the department can only buy a few of them each year. In the requirements process, as in the budget process, a vicious cycle is at work. Weapon acquisitions used to require a four- to five-year development cycle, which program stretchouts have now extended to more

The choice is between running fewer programs efficiently—delaying some until later years—and running all of the programs simultaneously and inefficiently.

comes along, and users want to incorporate it into the system too, so they change the requirements—add a new missile to the airplane, a new electronic warfare system to the ship, a new fire control system to the tank, and so forth.

During the development phase, the intelligence community is active as well. It picks up some new Soviet research and development activity and hypothesizes future changes to the threat on that basis. New requirements are generated as a result, necessitating further adjustments to—and costs for—the current U.S. program.

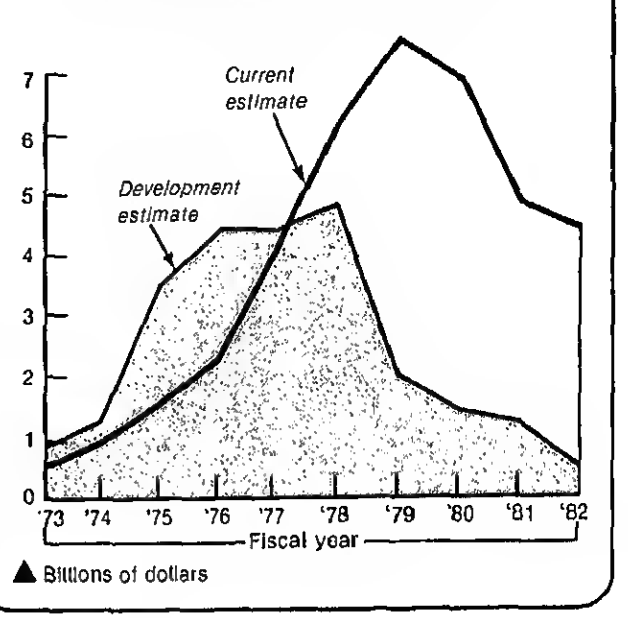
Requirements also change due to budget realities. If fewer total dollars are available or programs cost more than planned, the services have to reevaluate their priorities and frequently decide to live with fewer of each type of weapon in order to keep all of the programs in the budget. Thus, as previously noted, the quantities required often change from year to year, greatly destabilizing industrial production programs and causing associated inefficiencies. Corrective action should take the form of a true commitment to a stable set of priorities and programs, one which the services can sign up for and live with over a number of years.

Yet another cause of top-down instability in weapon system acquisition within a service is the incredible number of management layers between the service secretary and the program manager. For example, a typical service program includes perhaps 12 layers of management (either vertical or horizontal) through whom program reviews have to go. As a result, the review process may entail more than 40 briefings even before a program manager begins the program review cycle within the office of the secretary of defense. Of course, each of these briefings affords an opportunity to suggest "improvements," which many managers almost feel obligated to make—otherwise, "why hold the reviews?" In other words, each cycle of review presents some 40 opportunities for changes to the program.

Compounding this problem is the high rotation rate among both military and civilian management. Many of the people assigned to a program are new and often inexperienced, so the current manager may well reverse a change made by the last one. Thus, the very nature of the system tends to foster change; the acquisition cycle simply compounds the effects described above in the budget cycle. Correcting the problem requires reduced layers of management, fewer revisions to the program, and greater personnel stability.

All of these top-down disturbances, as already noted, would cause gross inefficiencies even in the management of a perfectly planned and executed weapon system program. However, perfect program execution is usually not

Figure 6. The "bow wave" effect of growing costs for seven large DoD programs



rush to begin a program and initiate it without having first proven the technology. Therefore, technical problems are almost inevitable and are usually not sufficiently budgeted for, either in time or dollars. Additionally, because of the need for optimism in the initial budgeting of a program (in order to get it started), rarely does a new program adequately plan or budget for contingencies or for the up-front dollars required to minimize risks—by funding multiple technology approaches, for example, or multiple, competitive contractors. More often, program officials have an ostrich-like mentality, that is, they assume no problems and maximum efficiency. Then, when these assumptions prove wrong, costs grow, programs are stretched, and costs grow further.

The government does know how to better estimate these likely costs. But it prefers to assume that each new program will be different, that it will not have technical, performance, budget, quantity, or other changes, and that it will not experience cost growths. However, data from U.S. General Accounting Office reports and from Department of Defense Systems Acquisition Reports to the Congress do not support such assumptions. They show that, for the average program, cost growth tends to produce overruns of about two to one. The causes are usually factors such as poor estimates, often in the guise of buy-ins; the addition of features not included initially, also referred to as unknowns; and technical problems not budgeted for,

both the Congress and the executive branch make a far greater commitment to achieving program stability—from the time a program enters full-scale development through final production. They must realize that the concept of the weapon system acquisition process as an incremental one is a myth. In reality, there is one critical decision—the authorization to proceed with full-scale development—that must be very carefully controlled. Historically, the services have cancelled extremely few programs once full-scale development has begun, nor has the president or the Congress. Thus, authorization of full-scale development is clearly a commitment to production. Officials must recognize this and accommodate it both in the budget and in force planning. The Congress can do this in two ways—by committing to a program's long-term stability when it approves full-scale development during the budget authorization process and by appropriating at least a two-year budget.

DoD can act more positively too, whether Congress makes these changes or not (although, obviously, far more easily if Congress cooperates). Specifically, the department should:

- Develop an integrated, long-range financial plan that ties resources to strategy and is fiscally constrained.
- Baseline all weapon systems, that is, commit itself not only to annual budgets and total dollars but also to program requirements, operational plans, logistics concepts, and quantities.
- Be more realistic about costs, both in planning and in programming.
- Prepare more carefully before authorizing full-scale development.

A brief look at each of these will help illustrate that, taken together, these four steps can have far greater impact on the stability, efficiency, and effectiveness of the DoD acquisition process than any one alone could have.

First, consider the development of an integrated, long-range fiscal plan. At this stage, the department must introduce affordability constraints on individual weapon systems and on the total number of programs to be pursued simultaneously. Such a plan also requires time-phased program initiation, that is, a determination, based on military priorities and budgetary realities, concerning which programs to start immediately and which to delay. If this is a plan put together with realistic estimates and agreed to by all of the senior military managers, the service secretaries, and the secretary of defense, then it should remain in effect for at least a few years and would thus introduce far

structure, strategy, and available resources. It would also require a restructuring of responsibilities within the office of the secretary of defense, specifically, a strengthening of that office's policy role but a curtailing of its involvement in the detailed execution of each weapon system acquisition.

Baselining of each weapon system, the second of the changes needed, is a concept the Air Force pioneered a few years ago on the B-1B program. The first step was an agreement that the service would acquire 100 B-1Bs for $20.6 billion. Air Force officials spent almost a year getting all of the four-star generals involved—users, developers, logisticians, and corporate staff—to commit themselves to the performance parameters, annual budgets, operational concepts, logistics plans, and so forth for these 100 aircraft. Since then, the service has managed the program within these dollars, and the requirements have largely stayed stable. As new issues come up, program management makes trade-offs between performance and cost.

This baselining approach has clearly protected the program manager from the "sharks" that continuously attempt to eat away at a program. For example, in order to live within the baseline, the Air Force went to Congress with a proposed multiyear contract for the B-1B. The legislature, which normally objects to such long-term commitments, especially on controversial programs, reluctantly agreed to go along because it recognized that the Air Force was serious about trying to maintain program stability. If DoD were to baseline a major share of its programs in this same way, the services (at each layer), the office of the secretary of defense, the Office of Management and Budget, and the Congress would all lose a great deal of the annual "flexibility" they now enjoy. But the department would also be taking a much-needed step toward greater program stability.

Long-range planning and program baselining will only work if realistic costs are a feature of both the plans and the baselines. Thus, the third of the needed changes is use of such costs in projecting future dollars likely to be available and in estimating program budgets required. The latter must include enough contingency dollars to cover both risks and likely program cost growths. It would be highly unrealistic to assume that annual program cost growths will suddenly fall from the historically large three- to five-percent range to zero—and remain there. Nonetheless, application of these improved management techniques should greatly reduce future cost growth. In fact, the administra-

On April 4, 1986, Deputy Secretary of Defense William H. Taft IV spoke to members of the National Security Industrial Association about the President's Blue Ribbon Commission on Defense Management, also known as the Packard Commission. In his remarks, Mr. Taft put in perspective the critical need for stability.

"The Packard Commission makes no more important point in its report than that there is an urgent need for stability in defense policy, programs, and budgets. Such stability is the principal objective of its recommendations in the planning and budgeting area and is vital to the success of many of the reforms proposed in the acquisition area. Whether such stability is realized depends not only on the executive branch's undertaking the actions announced by the president this week, but crucially on Congress. While Congress has been supportive in recent years of efforts to maintain stability in a number of particular programs, its record with regard to the defense budget as a whole has not been encouraging.

"Let us consider briefly, for example, the congressional request was consistent with the congressional budget resolution adopted in October 1984. By May 1985, a new budget resolution reduced the budget by $20 billion, with larger reductions in future years. The authorizing bill passed at that level, although the House version of that bill was prepared at a level $10 billion below the budget resolution. In November, the appropriation bill reduced the budget another $4 billion. In February 1986, the FY 1986 budget was reduced a further $11 billion by the application of Gramm-Rudman five months into the fiscal year. With the fiscal year more than half over, Congress is still considering a multi-billion dollar bill authorizing the obligation of certain of the funds in the appropriation act. While the theory of biennial budgeting recommended by the Packard Commission is loudly applauded on TV talk shows, the practice of bimonthly budgeting has been quietly and steadily gaining ground on Capitol Hill. The Packard Commission's objective of stability will not be realized unless this trend is reversed."

tion has been quite successful in moving in this direction over the last two years.

Finally, in order to achieve greater program stability, the Pentagon must resist the temptation to initiate programs prematurely. A weapon system is ready to enter full-scale development and production after it has met three major criteria. First, the program should have satisfied all conditions for baselining and the baseline itself should already exist. Second, the technology must have been sufficiently demonstrated to ensure minimum risks. Third, the baseline must include adequate dollars to cover such risk-reduction features as continuous competition, adequate testing, early production and logistics planning, and a short, efficient development and production cycle.

The Department of Defense urgently needs to improve its management of weapon systems acquisition, and the four steps just outlined will help it do so. The administration has already taken the first steps. However, in light of the significant defense budget crunches that are likely over the next few years, the department has reached a critical juncture. If it does not fully implement major acquisition reforms, program instability, stretchouts, and cost growths will accelerate, and public confidence in the department will plummet even further. As emphasized above, the solution lies in an across-the-board commitment to program and budget stability on the part of all branches of the government.

The institutional changes discussed in this article will all help a great deal. They include a multiyear budget, long-term authorization of weapon systems, long-term defense plans that are integrated and fiscally constrained, baselining of weapon systems, budget and program cost realism, improved pre-full-scale development activities, reduced management layers, and increased management experience and stability. But the principal change has to be a clear recognition of the inefficiencies associated with program instability. If the Congress and DoD truly realized the potential for dramatic efficiency gains, they would execute the cultural change necessary to achieve far greater program and budget stability. Our nation's security requires it, and the taxpayers deserve it. DMJ

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A group wage incentive system can boost performance and cut costs

By DEBORAH A. MOHR
JAMES A. RIEDEL
and
KENT S. CRAWFORD

Cost-conscious managers have a friend in Navy researchers, who are finding additional money-saving applications for performance-contingent reward systems.

The quest to improve the productivity of the federal work force continues, and the government has made real progress in this area. Performance-based reward systems are a notable example. The Navy Personnel Research and Development Center has demonstrated that this technique can indeed motivate individual employees to realize their maximum performance potential, and the payoff for the Navy has been handsome.*

But some jobs succeed or fail on the basis of teamwork rather than individual effort. Can a performance-based reward system boost group performance as well? To answer this question, Navy researchers developed, implemented, and evaluated a group wage incentive system for production workers at the Pearl Harbor Naval Shipyard. The goal of the project was to improve efficiency and reduce costs without negatively affecting adherence to schedules, product quality, or workers' attitudes toward their jobs. On all counts, the project proved a success.

The Pearl Harbor study was part of a continuing research program to investigate the effects of wage incentive systems at Navy industrial facilities. Previously, researchers had evaluated the effects of performance-contingent reward systems involving a variety of civil service employees, among them, key entry operators, small-purchase buyers, and aircraft engine mechanics. Under these systems, employees earned cash bonuses—incentive awards—for work performed above established standards. The more performance exceeded the standard, the larger the bonus. The rewards were paid through existing award programs and were in addition to employees' base salary. Further, the bonuses were recurrent, accruing as often as performance exceeded standards.

The Pearl Harbor effort differed from previous projects in that measures of group performance provided the basis for awards. Shipyard production workers typically work together in teams called work gangs. These work gangs consist of 10 to 20 employees supervised by one foreman. Thus, group rather than individual performance measures are more appropriate for assessing performance.

Setting up the system

Performance efficiency, the productivity measure used for this system, was calculated by dividing the manhours allowed to complete a work gang's jobs by the manhours actually expended to do the work. Work completed in exactly the time allotted to it resulted in a performance efficiency, also called a performance factor, of 100 percent. If a gang completed the same work in less time than allowed, its performance factor was greater than 100 percent

*See E. Chandler Shumate, Steven L. Dockstader, and Delbert

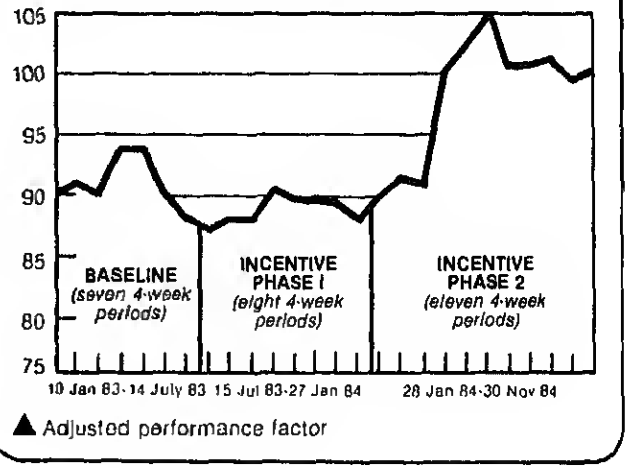
yard had already been routinely collecting the inputs to this measure, that is, manhours allowed and manhours expended. Manhours allowed are typically based on either historical data or on engineered standards. Prior to implementation of the project, the shipyard, with help from the Navy Personnel Research and Development Center, enhanced its management information system to more accurately measure performance efficiency and to provide monthly automated incentive award calculations and continual award tracking.

Under the performance-contingent reward system set up at Pearl Harbor, work gangs were eligible for awards whenever they saved manhours by completing their jobs in less time than the standards allowed. The shipyard shared the value of these saved hours with its employees in the form of incentive awards. It distributed the work gang's saved hours to members on the basis of each worker's contribution to the gang, that is, his or her portion of the gang's total work hours. The sharing rate used during testing of the system was 50 percent; the shipyard paid out half of the cost savings associated with a work gang's manhour savings to gang members as incentive awards, and it retained the remaining 50 percent. The actual value of each saved hour reflected the employee's accelerated hourly wage rate as defined by the comptroller.

Shop foremen participated in a similar incentive system. To encourage cooperation and better coordination, all foremen were considered as one group, which was eligible for awards whenever performance of the entire shop resulted in manhour savings. In addition, to encourage foremen to work together to help the shop improve, each foreman received a one-time bonus of $125 the first time the shop's performance factor exceeded 100 percent.

Historically, the shop selected for test of the incentive system had spent many more manhours to complete its work than standards allowed. Since the shipyard did not have an extensive methods and standards program, this discrepancy might have been the result of unrealistic standards rather than poor group performance. Given existing standards, few, if any, work gangs would have earned incentives, even though they might have been the best performers in the shop. Since incentive systems do not motivate employees to improve performance unless workers believe that the incentive standard is realistic and can actually be achieved, shipyard management decided to increase the hours allowed by 10 percent for purposes of subsequent award calculations. Thereafter, work gangs accrued manhour savings whenever their adjusted performance factors exceeded 100 percent and, likewise, foremen earned awards whenever the shop's adjusted performance factor exceeded 100 percent.

Figure 1. Results of Navy's test of a performance-contingent reward system for a group of machinists



and specifying responsibilities during the test period. The shipyard commander designated a senior military officer as project manager, and a general foreman within the test shop served as system coordinator. Shipyard management also negotiated an agreement with the local union to permit the trial to take place and obtained approval from the appropriate headquarters commands as well.

Finally, employees and supervisors in the test shop received training to assure their understanding of the enhanced performance measurement system and the group incentive system. The 30-minute sessions for workers covered the basic functioning of the system and their rights under it. Participation in the program was voluntary; however, less than 1 percent of the employees opted not to participate. Additional subjects covered during the hour-long session for foremen included steps that foremen should take to ensure the accuracy of the performance reports.

Following these preparations, the shipyard implemented test of the performance-contingent reward system in shop 31, the inside machine shop. Shop 31 is one of 17 production shops at the shipyard and employs approximately 480 wage grade employees and 23 foremen assigned to 18 work gangs. It was chosen as the test site because it is representative of large production shops at the shipyard and because it is the lead shop on many of the shipyard's important work packages. In general, management in shop 31 was very supportive of the experiment.

Performance and cost savings results

tracking about expectations, foremen began taking greater care in preparing employee time cards and in correcting labor rejects. This was a particularly important spinoff because labor charges are the major input to the database which supports the shipyard's management information system. Improving the accuracy of information in the database in turn improved the shipyard's ability to set appropriate customer charges, accurately measure performance and work status, and plan for future overhauls.

Similarly, foremen had not usually been reviewing work documents and related materials for completeness and accuracy until the work was ready to be started or had been started. As a result, work delays often occurred when the foremen found that the documents were inadequate or incorrect. Under the incentive system, they began reviewing these materials earlier, and thus the shipyard was able to identify and resolve problems before they resulted in major delays. Further, by alerting production support personnel such as planners to these problems, the shipyard could help forestall similar situations on future work packages.

The incentive system also encouraged managers to reallocate production employees in line with fluctuating workloads. Previously, managers had no strong incentive to transfer excess workers to areas which had adequate workload or to find other jobs for them to do. Shop 31's test program provided the impetus. Management transferred employees among the shop's work gangs, reassigned them to other jobs, and loaned them to other shops and departments. These actions gave shop 31 the opportunity to improve its performance and also provided the shipyard with additional workers in areas where they were needed.

Finally, by tying money to performance, the incentive system engendered a climate more conducive to improving productivity. Management at the shipyard took steps to sustain that momentum by setting up a shipyard-wide problem-solving team to resolve a number of long-standing problems that had proven to be impediments to greater efficiency.

productivity improvement systems in large industrial organizations. This success of the test system indicates that such issues are not insurmountable. The experience at Pearl Harbor also offers some important insights into dealing with four specific issues: incentive system design, job security, management support, and system expansion.

Early on, designers of an incentive system face an important decision. Should they develop a reward system contingent upon individual or group performance? In the case of Pearl Harbor, the choice was relatively easy and logical based on analysis of the shipyard's work settings. Implementation of a typical incentive system that used measures of individual performance would have been inappropriate and quite possibly dysfunctional. Above all, managers considering a performance-contingent reward system should realize that no standard, off-the-shelf system exists. Developers must tailor each system to fit the organization and its priorities.

Workers are unlikely to improve their productivity if, by so doing, they believe they are working themselves out of a job. In deciding whether or not to implement a performance improvement program, managers must continually address the balance between workload and staffing within the organization and must develop means to capitalize on the effects of resulting improvement.

During the design phase, managers must also specify a number of incentive system parameters. These include the goal to be rewarded, for example, efficiency, quality, or timeliness; the employees eligible for participation; the incentive level, that is, the performance level at which employees are eligible to earn awards; the sharing rate, or the proportion of cost savings shared with employees; and the savings distribution method for sharing savings among workers.

Other considerations

As noted earlier, in the case of Pearl Harbor, the system was based on measures of performance efficiency covering all the shops' work, and both production employees and foremen were eligible to participate. Further, those responsible for implementing the system dropped the incentive level to 90 percent because they believed that workers would view this level as attainable and thus would be motivated toward greater performance improvement. Pearl

the goals of the incentive system and the conditions that apply at their organization.

Job security is another critical issue. As mentioned earlier, during the test at Pearl Harbor, the shipyard experienced a rather significant reduction in workload. This development appeared to preclude performance improvement until shop 31 was able to balance its workload and staffing level. Regardless of the nature of the employment, workers are unlikely to improve their productivity if, by so doing, they believe they are working themselves out of a job. In deciding whether or not to implement a performance improvement program, managers must continually address the balance between workload and staffing within the organization and must develop means—normal attrition or increased workloads, for example—to capitalize on the effects of resulting improvement. When shop 31's workload declined, management transferred workers to areas that had sufficient work and also assigned them to facilities maintenance jobs.

Management's relationship to the incentive system is important too. The success of organizational change efforts such as performance-contingent reward systems depends at least in part on active support from management. A high degree of commitment to the program is necessary before and after implementation, commitment involving more than just verbal support. Specifically, management must be willing to allocate resources to develop, implement, and maintain the system. Programmers have to be available to process the data, for instance, and the organization's industrial relations office needs to play an active role too. Implementing effective change is difficult when either top management or those expected to implement the change are unsupportive.

Finally, the success of the test in shop 31 raised the issue of expanding the incentive system. Running such a system in just one shop is not feasible over the long term. In light of the proven cost savings from performance improvement, the only logical step is to expand to other shops. But managers must carefully consider both the means and extent of expansion before doing so. During expansion, they must take care to adapt the system to other sites and to continue to monitor its effectiveness. Management should also consider ways to include production support and other indirect workers in a performance-contingent reward system. Options available include development of unique systems for support workers, use of existing mechanisms such as sustained superior performance awards, or provisions that allow support staff to share in the benefits earned by shops. Testing of such an terms of encouraging people to work harder. At Pearl Harbor, the major impact of the system seems to have been encouraging people to work smarter! By linking money and performance, the incentive system forced both managers and workers to address a number of longstanding impediments to productivity. In agreeing to implement the system, top management was telling the workforce: "We will share productivity improvement savings with you." In response, foremen and workers said: "If you don't work with us to remove impediments to productivity, there is no way we can improve our performance." The importance of tapping this increased interest and enthusiasm for organizational improvement should not be underestimated.

Through the shop 31 project, the Pearl Harbor shipyard and the Navy Personnel Research and Development Center have demonstrated the feasibility and value of a group performance-contingent reward system. It remains for other federal managers to determine whether their organizations can also benefit from such systems. The many important payoffs that can result from incentive programs are clearly worth the investment of time and energy. DMJ

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Assessing the risk and return of military investments

By HSIU-KWANG WU
and
LIEUTENANT COMMANDER HOLLIS D. ARNOLD, USN

Defense officials who must choose among weapon systems must come to terms with risk on two fronts—cost and effectiveness. Fortunately, a tool is available to help make such decisions more rational and objective.

Based on the financial portfolio theory set forth more than 25 years ago by Harry S. Markowitz, the risk-versus-return approach to decision-making enables defense managers to consider effectiveness, deviation from effectiveness, and cost in a single model.[1] Using it, analysts can quantitatively compare tanks with infantry, Polaris platforms with intercontinental ballistic missiles, F-20s with F-16s, and, as will be discussed below, reactivated battleships with aircraft carriers—all from the perspective of force effectiveness. Defense planners seem not to have applied this theory to military budget decisions before, even though the potential for front-line applications in the defense sector is enormous.

Since the mid-1960s, defense officials have based expenditure decisions largely on systems analysis, a method designed to help users choose among alternatives that have varying costs and benefits. However, the systems analysis approach has several shortcomings, most notably its failure to address risk directly. It treats benefits, or expected performance, as firm and fixed once the acquisition decision is made. Systems analysis does not quantitatively take into account the very real possibility that benefits may fall short of expectations. Clearly, defense decision-makers need a model or analytical tool they can apply within a risk-versus-return framework.

Portfolio theory is a financial doctrine that is in fact applicable to any risk-versus-return decision, that is, to any choice "involving outcomes that cannot be predicted with complete certainty."[2] In finance, an investor determines either through analysis or by gut feeling the amount of risk he is willing to take for the expected return. A junior officer who has just saved his first $10,000, for example, may be reluctant to gamble on a get-rich-quick deal, even though the potential return is great. He may only be willing to put his money in a riskless, guaranteed-return investment such as a treasury bill.[3] Generally, a conservative risk offers a conservative rate of return. On the other hand, a senior officer who has saved $100,000 might opt for a high-risk investment such as oil exploration, in the hope of sizable returns. His risk may be high, but so too is the possible payoff. As the adage "No pain, no gain" applies to sports, so does "No risk, no return" apply to investments, financial or otherwise.

An understanding of risk is prerequisite to a discussion of its application to military expenditures. Risk is basically variation from expected return and can be depicted in a simple probability distribution. Put another way, risk represents the investor's belief regarding probable rate of return. If the junior officer is fully confident that his $10,000 investment will produce $11,000 at a specified

[1] *Harry S. Markowitz.* Portfolio Selection: Efficient Diversification of Investments *(New York: John Wiley, 1959).*

[2] *William F. Sharp,* Portfolio Theory and Capital Markets *(New York: McGraw-Hill, 1970), p.2.*

[3] *Face value may differ from real value by the factor of inflation. This article assumes a zero inflation factor.*

date, he perceives no deviation from the expected rate of return, thus no risk. However, the senior officer's high-risk oil-exploration venture may have a significant probability of deviation from expected return; nonetheless, the senior officer may still hope to, say, double his money. But he knows there is a good possibility he will not.

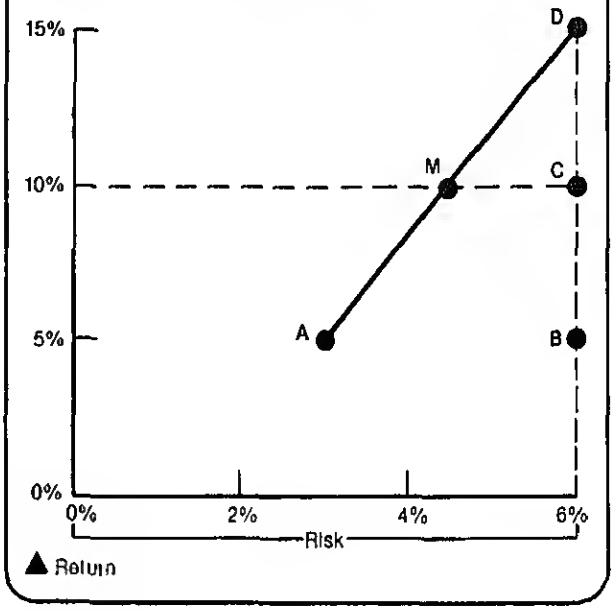
Conversely—unlike these two officers—some investors choose a desired level of expected return and accept the associated risk. In either case, the risk-return relationship is a choice made at the discretion of the investor, or, as in the discussion below, at the discretion of the defense buyer.

Principles and portfolios

If the junior officer just mentioned can obtain a 10-percent return from a treasury bill and 12 percent from credit union share purchases, he will invest in the latter. To not accept the higher return, given the same relatively low risk, would necessitate defining investors as irrational. (And rationality is assumed, even among the military!) What the officer's decision illustrates is the dominance principle, which states that for any given risk level, the asset with the highest expected return is preferred. Similarly, given a desired rate of return, the asset with the least risk is preferred. Or, in another context, if two weapon systems have the same survival capability and all factors, including cost, are equal, the decision-maker would choose the system with the greater offensive capability.

Consider the data in Figure 1, for example. An investor would logically invest in asset A rather than B if he desired a 5-percent rate of return—asset A, with its lower expected risk, dominates asset B. If the same investor were willing to accept an expected deviation of 6 percent, he would invest in asset D rather than in assets B or C. The dominance principle is no more than common sense expressed as a formula.[4]

Figure 1. Two-asset portfolio construction



In actuality, very few investors or defense decision-makers place all their funds in a single asset. The junior officer may place only $8,000 in the treasury bill and put the remainder in a higher-risk investment. The senior officer may invest only $50,000 in a high-risk proposition and place the rest in treasury bills. In making such allocations, both officers create portfolios. Likewise, the Department of Defense does not purchase only submarines, only tanks, or only fighter aircraft. It constructs a portfolio of diversified assets.

Since the mid-1960s, defense officials have based expenditure decisions largely on systems analysis. However, this approach has several shortcomings, most notably its failure to address risk directly.

Assume an investor, say the Navy, has funds to invest. In that case, as Figure 1 indicates, the service should consider only assets A and D in a two-asset portfolio. If the Navy wishes to diversify, it will put a portion of its funds in A, perhaps a carrier, and the rest in D, which might be a battleship. Line A–D in Figure 1 represents risk and re-

[4] *For more on the dominance principle of assets, see James C.*

equally in A and D, then M, which represents a combination of carrier and battleship groups, will produce the expected portfolio rate of return at lower risk than will C, which is a force of perhaps 15 destroyers. Thus, the dominance principle applies to portfolio assets just as it does to individual assets. Economists refer to dominant portfolios as efficient because they provide either higher returns for equal risk or lower risk for equal returns.

The chosen portfolio (represented by a point on the locus AD in Figure 1) reflects the distribution of investment funds among individual assets. The locus of efficient portfolios is called the efficient frontier. What is important to note is that the locus AD represents an infinite number of efficient portfolios which consist of various combinations of assets A and D.

Markowitz himself recognized that not all financial assets rise and fall in value at the same rate. In other words, a change in the value of one asset does not necessarily trigger an identical change in another—assets are not perfectly, positively correlated. For example, if oil industry workers go on a prolonged strike, the value of oil stock will likely fall as investors, foreseeing a decline in company profits, sell their stock. This dumping, which is simply an effect of supply and demand, lowers the price per share. But what happens to the price of related stocks? Shares in companies which construct oil platforms may also decline as the demand for new drilling sites recedes, but the dip probably will not directly parallel the drop in oil stock prices. Although the two stock values move in the same downward direction, the correlation is not one-for-one. By applying Markowitz's methodology for quantifying the related movement between assets, defense managers can calculate and integrate asset correlations for weapon systems into the risk factor of portfolios.

In light of this positive, but less-than-perfect correlation between most assets, one can logically conclude and in fact prove mathematically that the true locus AD is not linear. Applying Markowitz's mathematical framework, a decision-maker can construct Figure 2, which shows the extreme of correlations; locus AKD is perfectly, positively correlated (+1), and locus AED is perfectly, negatively correlated (−1). In addition, the figure depicts zero correlation at locus AJD. Because most financial asset correlations are less than 1 but greater than 0, the efficient frontier of portfolios usually lies somewhere within the ellipse AJDKA. In short, the efficient frontier is convex to the Y axis.

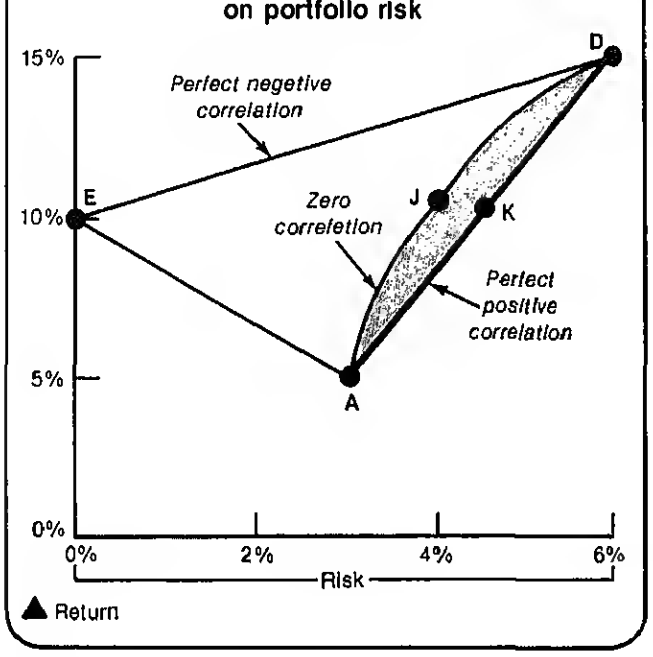
Thus, one can normally decrease risk by combining assets having less than perfectly, positively correlated benefits. Intuition alone would suggest that the risk factor associated with a portfolio consisting of an antisubmarine warfare aircraft and a nuclear attack submarine is far smaller than that of one consisting of two nuclear attack submarines. More simply stated, the asset combination of an antisubmarine warfare aircraft and a nuclear attack submarine has a greater chance of detecting an enemy submarine than do two attack submarines.

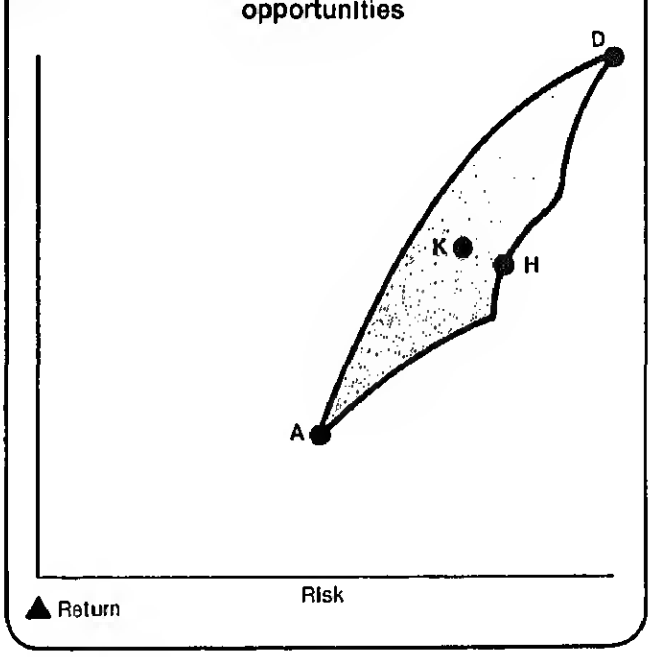
The graph in Figure 3 depicts a hypothetical set of typical investment opportunities. The area defined by ADHA represents the feasible set of investment opportunities, and AD represents the efficient set of portfolio opportunities—that is, the efficient frontier. Once the efficient frontier has been determined, portfolio selection becomes a matter of personal choice. Point A in Figure 3 might represent a conservative portfolio, and point D might be the holdings of an aggressive investor. The choice along the efficient frontier is a reflection of the investor's utility function, that is, his attitude toward trading off risk for return.

Complications

The predominant shortcoming of military operations research today is the lack of a standard criterion or measure for use throughout the decision-making process. In military acquisition, for instance, decision-makers use various criteria related to the content of the problem. Thus, if a service is buying replacement tires for bomber aircraft, its criteria may include pounds-per-square-inch inflation capability, anti-skid capability, and weight sustainability. For a study of alternative bomber forces, the criteria may be pounds of ordnance delivered per hour, enemy-territory

Recent media attention to the reactivation of four naval battleships warrants specific comment. Results of our study indicate that, from the point of view of risk and return, battleship groups are more efficient than carrier groups because of cost considerations.





penetration success, and survivability after payload delivery. In evaluating strategic weapon alternatives, officials may consider survivability after enemy attack, electronic jamming capability, and ability to abort. Different criteria apply in each instance. Two researchers, Bernard Koopman and Charles J. Hitch, recognized this nonstandardization and its attendant problems even before operations research became widespread within the Department of Defense.[5]

Though historical methodology has provided a framework within which defense managers can organize decisions, the process still lacks a standard criterion for transcending the various levels of military acquisition decision-making. The inability to aggregate multilevel criteria leads to vagueness and increased subjectivity, and the Department of Defense is in fact no closer to having a standardized measure of military worth now than in the 1950s. Yet standardized comparison methods are clearly necessary to ensure selection of the most efficient systems.

Unfortunately, defense strategists perceive current quantitative procedures of military valuation as an obstacle to effective judgment. Today, decision-makers plead their case before Congress using operations research-developed data that do include surrogates for return comparisons. However, they cannot quantifiably combine individual weapon system performance indexes under the umbrella of operations research. At this point, therefore, defense decision-makers are forced to rely on subjective arguments to support their hardware acquisition requests. Managers and analysts well-versed in defense matters fully respect these because the rationale offered has solid grounding in the realm of experience. But the audience hearing the plea is demanding more. A process that aggregates individual risk-and-return indexes can give defense managers a credible basis on which to make and defend decisions.

Risk and return

Return in the world of finance is the percent change in the value of an investor's dollar over some specified time, and the return on investments in weapon systems should be equally quantifiable. Weapon system effectiveness and cost are two variables that warrant inclusion in any measure of return on the military dollar. To measure the first of these, effectiveness, analysts take a sample of weapon performance. For instance, 95 aircraft kills out of 100 attempts by ground-to-air missiles would equate to an expected effectiveness of 95 percent. Traditionally, analysts have combined both variables in a measure that defines efficiency as expected effectiveness divided by expected cost. In this equation, expected effectiveness is a dimensionless scale of destruction capability.

[5]*Bernard O. Koopman, "Fallacies In Operations Research,"* Operations Research, *August 1956, pp. 422-430; Charles J. Hitch, "Economics and Military Operations Research,"* Review of Economics and Statistics, *August 1958, p. 200.*

graphed on an effectiveness-cost plane. It is represented by the slope of a line that begins at the point of origin and passes through a data point in the plane. For example, let weapons A and B have effectiveness measures of 90 and 80 percent, respectively. If each weapon costs $15, then the efficiency of weapon A ($13.50) is greater than that of weapon B ($12.00).

Efficiency can serve as the measure for rate of return on military investments. The effectiveness variable in the efficiency equation includes elements such as reliability, destructive effectiveness, and dependability, which are of primary concern to military strategists. The equation also takes into account the cost variable, which is the primary concern of many members of Congress. No other variables have as much informational content as do effectiveness and cost. Offering both simplicity and inclusiveness, efficiency is highly desirable as a measure of expected military rate of return.

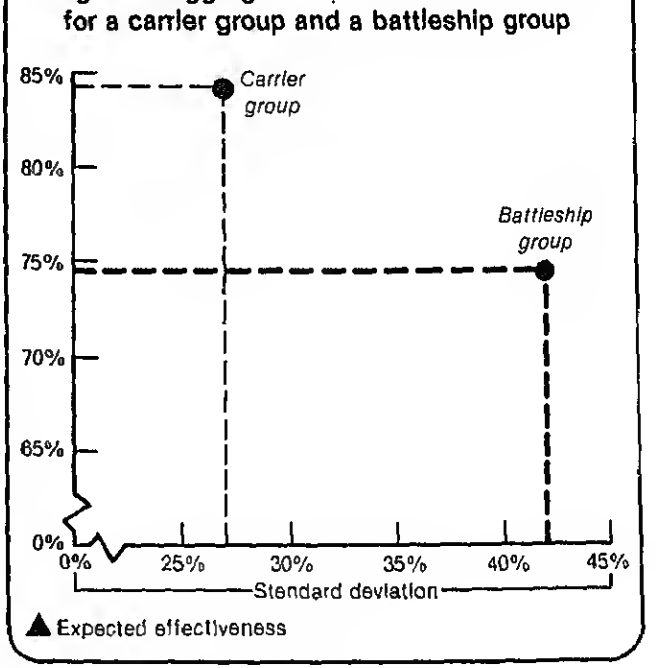
Risk in a military context can be defined as deviation from expected return, just as it is in traditional financial theory. Analysts can depict this deviation in a probability-distribution framework developed from sampling data. The traditional risk-assessment mindset regards an asset which detects incoming missiles as a key factor affecting the expected survivability of U.S. forces. But this perspective is invalid in the context of portfolio application. A more appropriate analysis considers that the asset has an expected performance index, say a 90-percent effectiveness level, and that the risk measure is the deviation from that expected level of performance. The definition of expected return determines the meaning of risk. By itself, risk has no significance.

To determine probability distributions for rates of return on military investments, analysts build a framework based on individual weapon system test results. Test results on tonnage of ordnance delivered per hour, for example, are objective and analysts can display multiple results in a probability distribution space. This same framework is applicable to aircraft and missile kills, detection of enemy submarines, and radar detection of enemy aircraft and missiles. All of these criteria relate to the defensive and offensive abilities of carrier and battleship groups.

A military effectiveness index

The technique for aggregating individual weapon system performance into a total expected effectiveness measure—a military effectiveness index—is statistically simple. For each of the weapon systems mentioned above, analysts can use the measure of effectiveness to calculate an average value of performance. They base these calculations on samples from either the real world or simulations.

for a carrier group and a battleship group

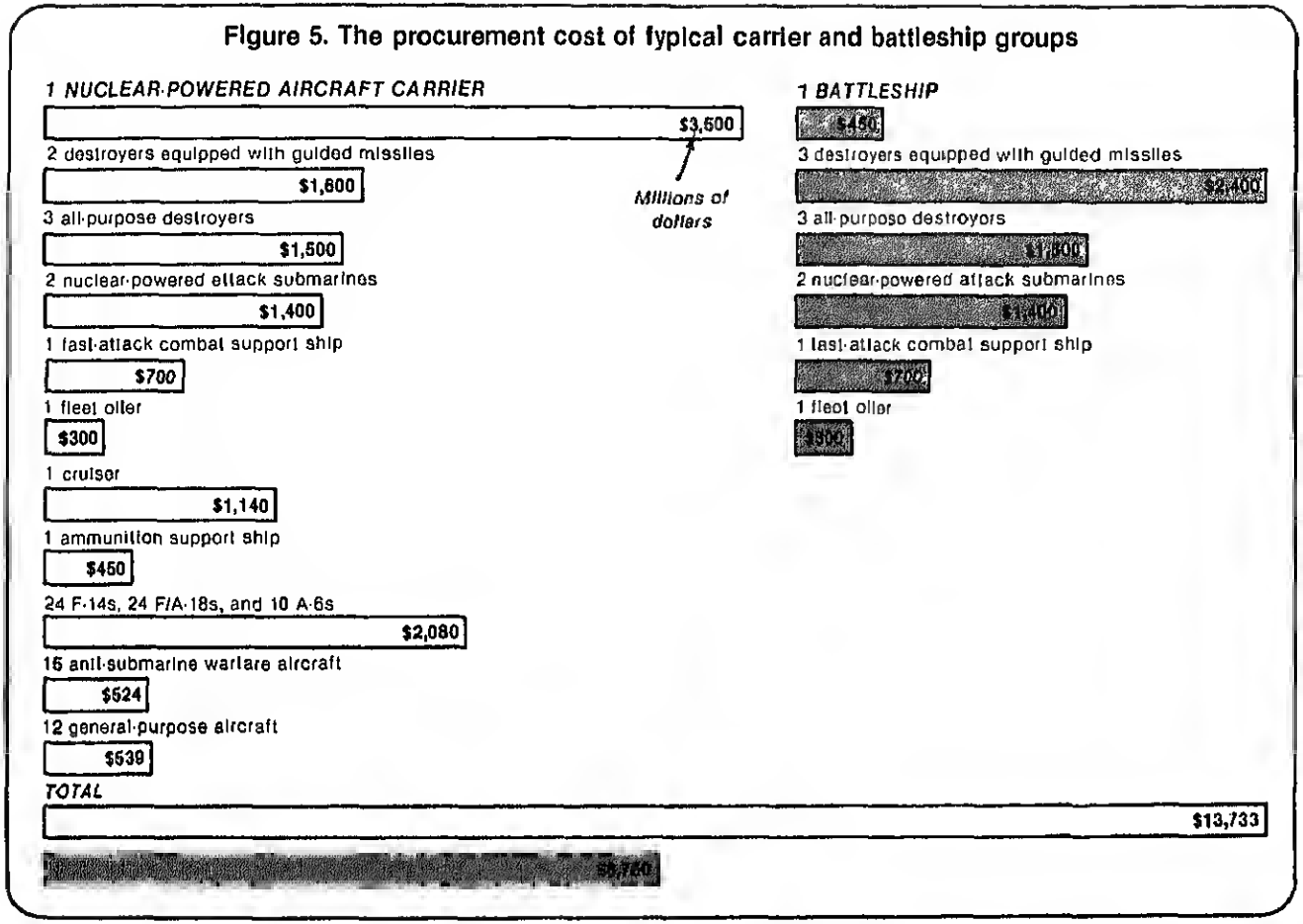


In a fleet exercise, for example, deleting 85 out of 100 enemy submarine penetration attempts indicates an effectiveness of 85 percent. Similar data collection in the other three categories produces parallel quantitative values.

Using statistically correct methodology, analysts next combine these individual performance measures, which are in fact individual weapon system effectiveness indexes presented within a context of probability distribution. The result is a single, aggregate index of expected weapon effectiveness. The analysts can develop possible deviations from it and express them in terms of either standard deviation or square variance.

As Figure 4 shows, the carrier-versus-battleship analysis yields no trade-off similar to the financial return-and-risk trade-off. The decision-maker will always opt for a carrier group because of its greater expected effectiveness and lower expected deviation from that effectiveness. The missing element is cost, which decision-makers can incorporate by using the efficiency equation discussed above. They will thereby obtain a performance measure tempered by dollars—an efficiency index. Likewise, by tempering the variance of the effectiveness measure, they can obtain a risk index.

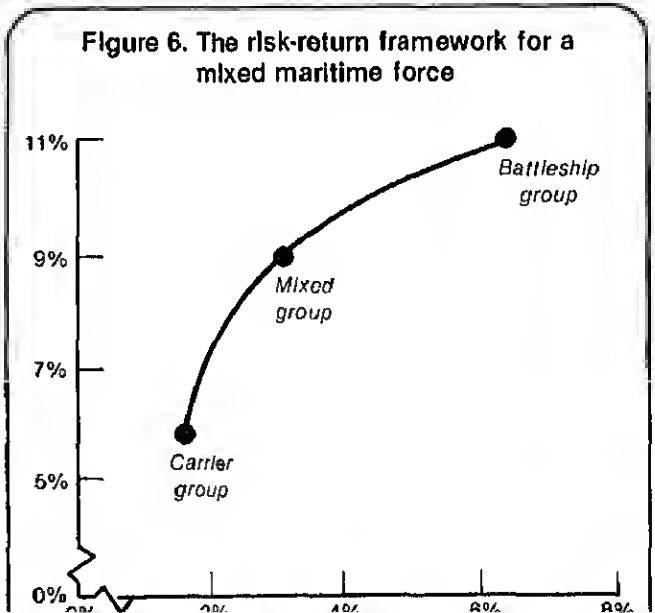
Using the expected effectiveness data contained in Figure 4, the cost data in Figure 5, and the efficiency equation, an analyst can express the rate of return on dollars invested in a carrier group and in a battleship group as follows. For the former, an expected effectiveness of 0.845 divided by an expected cost of $13,733 yields a



6.5-percent rate of return. For the latter, the variables are 0.743 and $6,750, and the resulting rate of return is 11.01 percent.

Just as efficiency equals effectiveness divided by cost, so too the variance of the efficiency equals the variance of the effectiveness divided by cost. Because the effectiveness measurement is on a scale of dollars, continuity demands that the risk variable be on the same scale. Therefore the scaled risk variable is equal to the effectiveness measure divided by the cost squared. Given this information, an analyst can work through the calculations below to arrive at the scaled variance and standard deviation from the expected rate of return on the investments just described; Figure 6 plots the results.

In the case of the carrier group's effectiveness, the scaled variance equals 0.074 divided by 13.733 squared, or 0.004; the scaled standard deviation is simply the scaled variance raised to the 0.5 power, or 0.02, that is, 2 percent. The calculations are the same for the battleship



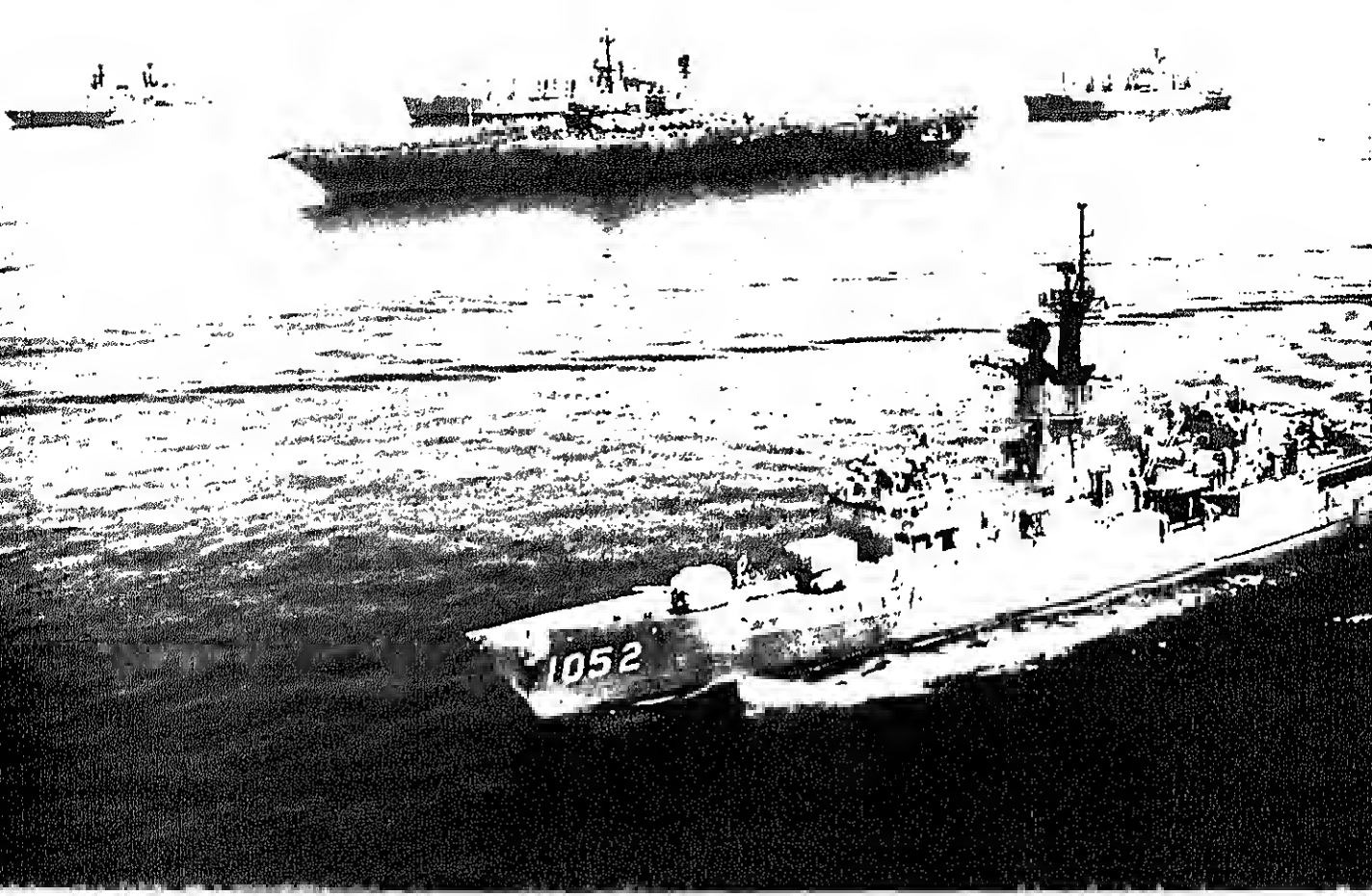
According to the authors, reactivation of a battleship—a once-in-a-lifetime opportunity—costs about $450 million, one-eighth of the price of an aircraft carrier. Thus, battleship groups are more efficient than carrier groups from the point of view of risk versus return.

In keeping with the traditional financial methodology presented earlier, a defense manager can construct a two-asset portfolio that consists of both carrier and battleship groups. As before, the proportion of funds placed in each asset dictates the specific point at which the portfolio falls on the carrier-battleship locus. And, as in the realm of finance, the locus is convex and mathematically provable. Likewise, a proportionality of investment in both assets produces a point along the locus that represents a combined portfolio and associated risk.

Assume, for example, that a decision-maker allocates funds in order to acquire the mixed force shown in Figure 6 (p. 23). In developing this mixed force, the official either sets a desired level of effectiveness or a limit on the level of risk he is willing to take. The entire process is highly quantifiable, and this quantification enables the decision-maker to present definitive numbers to Congress and other funding authorities.

Moreover, given the set of efficient portfolios, defense officials can make a choice based on their predisposition toward risk and return. Theoretically, this choice will reflect the collective attitude of society. Society, or society's conscience, might place a low acceptable limit on the rate of return expected from military investment, implying a desire for a small defense budget regardless of the risk factor. Conversely, society might demand a low level of risk at the expense of a lower expected rate of return, thus implying its desire for a large defense budget. Normally, society allows a surrogate, the Congress or the president, to choose the nation's weaponry portfolio.

Recent media attention to the reactivation of four naval battleships warrants specific comment. Results of our study indicate that, from the point of view of risk and return, battleship groups are more efficient than carrier groups because of cost considerations. The reactivation of a battleship costs about $450 million; the price of an aircraft carrier is about $3.5 billion. But reactivation has of-



U.S. NAVY PHOTOS

fered a once-in-a-lifetime opportunity. Certainly, the cost of constructing a battleship from the keel up, at specifications equal to those of the reactivated ships, would be prohibitive.

The methodology discussed here is not intended to supplant the scenario approach to defense decision-making. Nor is it meant to downplay the importance of subjective input from experienced military and civilian officials. It is simply an additional tool to help defense decision-makers justify budgets and measure effectiveness.

Quantification of military needs and weapon system effectiveness will always be a sensitive issue. But the risk-versus-return approach should at least help reduce the historical distrust between resource analysts and military strategists. It is a methodology that represents the first attempt to apply Markowitz's financial theory to defense decision-making, and it gives the military manager an opportunity to consider effectiveness, deviation from effectiveness, and cost in a single model. Defense officials can use it to determine objectively the most efficient weapon versely, given any level of efficiency demanded, the model will enable officials to determine the best possible level of risk at that junction of effectiveness and cost.

DMJ

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In search of excellence: a military perspective

By BRIGADIER GENERAL JAMES D. KELLIM, USAF
and
TIMOTHY R. KECK

As one Air Force activity recently discovered, defense managers can learn some valuable lessons from America's best-run companies, among them that people have to be allowed to achieve.

Few recent developments in organizational theory have had more impact than Thomas J. Peters and Robert H. Waterman's *In Search of Excellence: Lessons From America's Best-Run Companies.*[1] This book, and a television treatment of it, have sent managers throughout corporate America scurrying to incorporate the practices of the best-run companies into their own operations.

The potential benefits are impressive. They include increased productivity, improved quality, and reduced personnel turnover, to cite just a few. Such benefits can spell the difference between profit and loss and help explain why the book became a best seller. However, some analysts doubt that the lessons contained in Peters and Waterman's assessment of American industry are directly applicable to the military. In their view, the absence of a profit motive deprives the military of the necessary enforcement mechanism.

Yet many of the traits common to the best-run companies relate to the way they treat their people, and generally, members of private and public sector organizations face similar day-to-day challenges in this area. No reference to profit or loss is necessary in order to appreciate the value of sound organizational communication or the importance of recognizing outstanding performance, encouraging individual growth, and merging individuals with corporate goals so that an organization can realize its long-term objectives. The authors stress these fundamentals throughout *In Search of Excellence*, and we believe they apply to virtually all organizations, including the military.

The services' mission—safeguarding the peace and security of the country—is so important that any source of help in motivating people to do their jobs better deserves serious attention. Based on results of a two-year trial program in which one Air Force activity applied the concepts set forth in *In Search of Excellence*, we are convinced that the potential for tangible, documentable improvement throughout DoD is enormous.

The excellent company

When the military applies lessons learned from the private sector to a defense environment, the fit is probably less than exact. What defense managers need as a starting point is a composite model of an "excellent company," as defined by Peters and Waterman, irrespective of the prod-

[1] *Thomas J. Peters and Robert H. Waterman*, In Search of Excellence: Lessons from America's Best-Run Companies *(New York: Harper & Row, 1982). Recently published on the same subject are Craig R. Hickman and Michael A. Silva*, Creating Excellence: Managing Corporate Culture, Strategy, and Change

"gross overcommunication," which convey the message thousands of times in thousands of little ways, until the company's goals and values become inseparable from the process of doing business.

The excellent company's organizational structure is flexible and fluid, and it consists of as few levels of management as necessary. The firm is able to split off individuals or groups to work finite projects and can abolish or add organizational elements while still retaining the viability of the general structure. Despite this flexibility, the excellent company continuously evaluates its structure in the context of the organization's overall objective. Additionally, it does not diversify and broaden its mission to the extent that the organization cannot meet its basic commitments.

The excellent company lives customer service. So important is this one facet that it becomes the lifeblood of the organization. The company seeks out, listens to, and analyzes customers; it is rigorously intent on meeting customers' needs and providing them with products and services of uniformly high quality.

A "people orientation" is the cornerstone of the excellent company's management philosophy. It achieves and maintains product quality through its people; the firm respects its employees and demands their best. Excellent companies encourage autonomy, creativity, risk-taking, sharing, and triumph, and they close the loop with a vigorous and highly visible reward system. Managers in such firms actively relate to their employees. They often practice management-by-wandering-around, but paradoxically, as management becomes more involved with employees, individual workers gain more job responsibility and autonomy.

The theoretical consequence of this people-centered approach is somewhat abstract, but it is important. The excellent company looks at the need for self-actualization as a prescriptive formula, not merely a stage certain individuals reach. In other words, the company has an obligation to create an environment which encourages employees to realize their full potential. Work is not simply a means to an end in such an organization, but a vehicle through which human beings can bring to fruition their very best and most human qualities. In short, by providing a creative outlet for its employees, the excellent company harnesses the many skills and talents individuals bring to their work situation. Company performance, that is, production, service, and profit, reflects the actualization of these human assets.

Can this model serve as a guide and barometer in a military organization? The experiences of the Air Reserve Personnel Center and its initiatives illustrate that a military organization can indeed fashion a mission approach which incorporates several of the predominant principles delineated by Peters and Waterman.

The Air Reserve Personnel Center employs some 700 DoD civilians and approximately 175 military personnel. It provides administrative support for the mobilization of Air Reserve forces in the event of war or national emergency. In peacetime, it performs the many personnel administration services required by 250,000 members of the Air Force Reserve and Air National Guard. On the center's payroll are personnel technicians and clerks, microfilm specialists, quality assurance analysts, computer programmers, and training specialists. Much of the work is typical of that done in automated office environments in the private sector.

Redressing "horror stories"

In spring 1983, the center was experiencing some significant problems. During field visits, staffers often heard unsolicited "horror stories" from dissatisfied customers, who complained that service was indifferent, slow, and unresponsive to their needs and that quality was unreliable. Nor was this perception unfounded. For example, the average time to process reservist tour orders—a basically routine task—exceeded four weeks, and during workload peaks, it often took six weeks or longer. In 10 percent of the cases, the reservist had completed the tour before he or she received orders authorizing it. Moreover, the net accuracy of all center transactions, as measured by acceptance by automated systems and requests for change or correction, hovered around 85 percent. Clearly, improvement was needed.

To cope with these and similar situations, analysts conducted a top-to-bottom evaluation of all factors bearing on mission performance. A review of institutional factors indicated that physical conditions were not to blame. The facility was new and pleasant, and equipment and manning levels were generally in line with Air Force standards. Nonetheless, a severe morale problem was evident and its correction became a project of highest priority.

Senior-level management realized it had to identify and quantify problems that employees perceived as hindrances to doing their jobs better. At command request, therefore, the Air Force Leadership and Management Development Center surveyed the work force and identified several notable deficiencies—ineffective organizational communication, particularly through the vertical channel, and a wide-

performance was not rewarded, that the promotion system was unfair, and that job training was not adequate.

To address these problems, the center took an approach anchored in three premises common to many firms Peters and Waterman examined. The first is the belief that people are an organization's most important resource and that management must tirelessly communicate this message to them. The second is that people want and indeed desperately need to know that what they are doing is important; they must be aware of their own importance in getting the job done. The third holds that people have to be allowed to achieve and, just as important, must be recognized for doing their jobs well. In essence, this value set is "productivity through people," and putting it into practice became the center's foremost objective.

The first step was to define and communicate to employees the importance of the center's mission; as a vehicle for doing so, management used traditional methods of organizational communication. Discussions during senior staff meetings were vital to management's understanding and acceptance of the approach. The commander's call, a monthly gathering of all military and civilian personnel, was the primary means for informing workers about possible threats to national security and the center's role in protecting it. Senior managers reminded employees that mobilization of all Air Reserve assets would almost double the size of the Air Force; given the center's involvement in nearly every phase of mobilization, its mission performance would therefore be critical to the service's emergency capability. Simply stated, the message was: "If we do our job right, we can help the country be so strong militarily that aggressors will be deterred."

Admittedly, it was a simplified argument, but one that management could defend and one that it reiterated at every opportunity. At staff meetings and award and promotion ceremonies, in internal publications and external briefings, managers relentlessly drove home the precept that center personnel are important because what they do is important. And when the "importance of the center" became the butt of inside jokes, management did not reduce the emphasis, for the banter signaled that the desired awareness had permeated all organizational levels and could be built upon.

Formal contacts are not enough, however; they are too infrequent and too impersonal. The center needed additional measures, and consequently the commander encouraged managers to get out into the workplace and deliver the message personally, a technique sometimes referred to as management by "wandering around." The purpose of these informal, unannounced visits was to make contact with the workers. In an effort to promote the practice, the commander initiated his own [illegible]

level.

Also, the staff published an Air Reserve Personnel Center information brochure for visitors, newcomers, and employees. As the following passage from the introduction indicates, the booklet highlighted the organization's belief in the importance of its mission and its people:

> *"We believe that the Air Reserve Personnel Center is a fine place to work. We believe we have an indispensable role in our national defense. We also believe in the capacity and willingness of people to achieve. You will find us willing to listen to you. You will find us constantly on the lookout for ideas—from whatever corner and level—to help us do our jobs better and support our people better. As an employee of the center, you are our most valuable resource. You are also the member of a proud team dedicated to excellence."*

This approach was new to many employees, and they were somewhat wary at first. Management had to persevere because workers, sharing in the healthy skepticism common to any organization, were accustomed to the introduction of new programs and ideas that soon fizzled, faded, and were forgotten. Six months passed before people began to believe in management's sincerity and respond accordingly, as evidenced by inputs to the commander's question-and-answer program, feedback from commander's calls, and increased participation in the Air Force suggestion program.

Awards and training

A major factor in the success of the management improvement program was the center's insistence on translating executive pronouncements into observable, measurable, and practical action. The organization vigorously applied this principle to the employee recognition and training program, which supervisors and employees alike had identified in the survey as needing improvement.

First, management encouraged supervisors to increase the quality and quantity of the informal recognition given to employees. Most frequently, this took the form of verbal compliments at the work station in front of the employee's peers. Many supervisors expanded on this practice by citing examples of good work and giving slightly more formal recognition in sublevel staff meetings.

Of course, some managers and supervisors were more enthusiastic and willing to embrace the new approach than others. To broaden acceptance and set an example, managers recognized promotions to supervisory positions, letters

ILLUSTRATION BY DAVID ERICKSON

achievements during weekly staff meetings. Each gathering represented an opportunity to express appreciation for good performance and spotlight the importance of individuals and their contribution to the mission.

Management also greatly increased emphasis on tangible awards during fiscal year 1984. In effect, this enabled senior leadership to "put its money where its mouth was" and reinforced its seriousness and sincerity in establishing the policy. The intent was not to hand out awards like candy samples, but rather to fairly recognize the majority of hardworking employees, perhaps 75 percent to 80 percent, whose efforts made the organization function. Senior management doubled the money set aside for cash awards and subsequently made it available to directors for distri-

The augmented awards budget resulted in roughly a two-fold increase in the number of awardees. Both the program and the award recipients received prominent attention at commander's calls and staff meetings.

In addition, the center implemented a civilian employee recognition program which paralleled the airman and non-commissioned officer of the quarter and year programs. This long-overdue initiative helped change civilian workers' long-standing perception that they were second-class employees. Forms of recognition were varied and significant: permanent inscription of winners' names in a lobby display, a personalized command plaque, a $50 cash award from the commander's special morale and welfare fund, and perhaps most coveted of all, 90 days of reserved parking for the quarterly winners and a year of reserved parking for the annual winners.

The response to these initiatives was overwhelmingly positive. The increase in informal recognition and the greatly expanded formal awards and recognition program let workers know that management was serious about encouraging and rewarding excellence in the workplace. As a result, the work atmosphere at the center improved, as did internal communication. Especially gratifying was a 200-percent increase in participation in the commander's question-and-answer program. Previously, most submissions had been minor complaints, but as the new approach took hold, the tone and content changed. Complaints began to be phrased in terms of "since you finally fixed this, how about fixing that." A steadily increasing number of submissions complained or asked about nothing; they simply said "thanks." And most importantly, productivity began to increase.

The center's increased investment in training had one overriding justification: people had to have proper training if management expected them to find better ways to do their jobs. But motivation was also an important consideration; the investment in people's skills bolstered the perception that management was committed to the program and to the employees.

The center expanded its formal training program in several ways. For example, it established an office to identify training needs and assist with on-the-job and other training programs. In addition, FY 1984 saw a 40-percent increase in outlays for classroom training either sponsored by the Office of Personnel Management or delivered by private consultants. The center also used in-house resources to develop a number of training programs, the most significant of which was a three-day course for new supervisors. It afforded management an opportunity to introduce new supervisors to the center's people-centered management philosophy and to the practical skills they would need to

Quality through employee involvement

Overall, the center's people-oriented management approach sought to integrate recognition, awards, training, and other morale and motivational initiatives into a corresponding improvement in customer service and product quality. Like most organizations, the center traditionally had maintained a quality control function to ferret out inadequate performance and provide justification for remedial action. And first-line supervisors as well as employees perceived its role in just that way. Therefore, management redirected the quality control function to emphasize identification and reinforcement of sound performance and careful documentation of improvement.

As in the case of other aspects of the total program, the center phased in this initiative. The first step was to nurture support for the new thrust within the senior staff. This was accomplished through a detailed presentation on what the revised approach to quality control was expected to achieve and the action that would be taken to implement it.

The second step was to ensure that the work force was aware of this emphasis on quality and management's approach to achieving it. Consequently, management launched a campaign to publicize exceptional organizational achievements throughout the center. The most popular form of publicity were building-wide public-address announcements citing branches or divisions that had exceeded established quality levels. Officials printed these announcements in the commander's call newsletter and posted them on bulletin boards as well. In addition, copies of all laudatory letters from activities outside the center were prominently displayed on bulletin boards. By the end of FY 1985 and concurrent with the expansion of the "management assistance" approach to quality assurance, all of the center's line organizations had implemented quality assurance programs that featured regular reporting and formal recognition for work well done.

As management increasingly shifted its focus toward improving the center's quality of service, it became extremely important that the employees felt they were part of the team, part of the process, and individually and collectively involved in the business. To reinforce this perception, management encouraged the formation of task forces and working groups within and among individual offices and directorates. Presently, members of these ad hoc groups are addressing some of the center's most significant technological, legislative, and mission-oriented issues.

One such group is doing the legwork to prepare for the prospective enactment of the Reserve Officer Promotion [illegible] the mission of the Air Reserve Personnel Center. The task force, which comprises three at-large members and one member from each directorate, is examining all facets of the act, identifying provisions that need interpretation or clarification, and determining what steps the center must take to ensure smooth implementation of the law.

Another example is the human resources committee. Made up of about 20 volunteers selected proportionally from each directorate, it represents a cross section of the center's nonmanagement work force. The committee's charter is intentionally broad; the group is to surface and address issues involving the work environment, morale, mission effectiveness, and communication, and it is to bring these matters, ideas, and proposed solutions directly to the commander. The danger, of course, is that employees will view such an effort as another "project of the month" idea or, conversely, that managers will go underground to torpedo its effectiveness, as often happens to quality circles.[2]

In light of the center's organizational climate, however, the risk seemed worth taking since it could yield significant payoffs. Specifically, it could increase employee involvement in effecting mission and environmental improvements, promote a creative problem-solving atmosphere, and, just as important as any tangible initiative, provide additional evidence of management's respect for and appreciation of employees and their tremendous contribution to the mission.

The payoff

As expected, it took time for the changes to produce measurable results. Employees did not overcome their negative feelings quickly, but after six months, significant improvement was evident. For example, unsolicited letters of appreciation, so rare in the past, began arriving. They cited the committed, "can do" attitude of the center's representatives. Many letters, especially those received in the early phases of the program, remarked favorably about the unexpected change. By the spring of 1985, these letters were arriving at a rate of more than ten per month, thereby exceeding in one month the total number of letters received in the entire year before.

Responsiveness and quality zoomed as well, as did productivity throughout most of the center. The time required to process reservist tour orders, for example, dropped from

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[2]*For a detailed assessment of quality circles, see Edward E. Lawler III and Susan A. Mohrman, "Quality Circles After the Fad," Harvard Business Review, January-February 1985, pp.*

fits of automation and streamlined procedures in addition to the turnaround in work force attitude. Clearly, though, the changes in hardware and procedures would not have

make training more effective, expand quality assura encompass job satisfaction and other related issues improve the organizational climate for employees

In 20 years, the manager, executive, or commander who wishes to succeed will, as a matter of course, anchor his or her management philosophy firmly on the notions of respect for the individual and productivity through people.

succeeded without the dedication of the employees responsible for implementing them.

Quality levels, which previously hovered around 80 percent, grew markedly too. In September 1985, levels at most functions being monitored stood at 95 percent or above, with 13 of the 18 work centers meeting or exceeding quality goals. Four achieved perfect records. Perhaps most gratifying was the fact that work centers attained these quality levels even as the volume of transactions was increasing in some areas by as much as 22 percent.

Clearly, the growth in mission capability at the Air Reserve Personnel Center during the past two years has been significant. To assert that it was exclusively the result of applying principles set forth in *In Search of Excellence* would be simplistic. Nonetheless, management at the center is convinced that people orientation was the key to success; it was the *mechanism* that facilitated introduction of new procedures, processes, and equipment, which in turn led to better quality and greater productivity. The improvement in attitude and customer awareness is due almost entirely to the new approach.

The discussion above has outlined the center's approach to many of the salient issues covered in *In Search of Excellence*. But the intent has not been to imply that the Air Reserve Personnel Center completely personifies excellent companies. Rather, the article treats one organization's attempt to put certain ideas into practice and it shows that selected concepts of excellence are important and transferable to the public sector in general and to military management and leadership in particular. The center does not claim to have arrived. Such a destination is elusive and may not even exist. Managers and commanders who seek to practice people-centered management and who care deeply about their people and their mission in effect undertake a never-ending journey in quest of the ultimately efficient and humanistic organization.

the motive for this commitment wholly altruistic. The ter knows that the people-centered approach—th proach taken by excellent companies—is the best w manage now and most assuredly will be in the futur

In fact, in 20 years, this approach will not be unus or controversial at all. It will simply represent the d nant cultural strategy of American enterprise in bot public and private sector. And the manager, executive, commander who wishes to succeed will, as a matter course, anchor his or her management philosophy f on the notions of respect for the individual and produ ity through people. DMJ

At the time he wrote this article, BRIGADIER GENERAL JAMES D. KELLIM, USAF, was commander Air Reserve Personnel Center, Lowry Air Force Denver, Colorado. During his two years in that p he spearheaded an array of productivity-enhancing management improvement initiatives. Presently, Brig. General Kellim is the vice commander of the Mil Traffic Management Command, Falls Church, Virg graduate of the Air Command and Staff College, ha a bachelor's degree in accounting, management, and keting from Memphis State University and a master gree in management from Auburn University.

During his tenure as assistant division chief for tr and productivity enhancement at the Air Reserve Pe nel Center, TIMOTHY R. KECK orchestrated adop many job-enrichment and employee-development tives. A former Ford Fellow and Fulbright Schol earned a bachelor's degree in history from the Uni of Colorado and a doctorate of philosophy from th versity of Wisconsin. Presently, Dr. Keck is staff his for Headquarters Pacific Air Forces, Hickam Air Base, Hawaii.

A proven approach to making the right logistic decisions

By MARK S. SCHANKMAN

A new decision-making tool can help weapon system managers boost readiness and avoid unnecessary support costs. Consider the experience of McDonnell Douglas on the F/A-18.

Supporting new weapon systems poses a perennial problem. How can the logistics manager maximize operational readiness and at the same time minimize support costs? A weapon system involves numerous support elements, and each affects readiness. Assuring availability of the most cost-effective quantity of these resources—spare parts, support equipment, and manpower, for example—at the proper time is difficult because the actual reliability and maintainability of each component is uncertain. Faced with just such a challenge on the Navy's fighter aircraft, the F/A-18 Hornet, logistics engineers at McDonnell Douglas Corporation forged a new analytical tool, readily adaptable to other weapon systems, that eased their task considerably.

With the aid of computer simulation models, analysts have been able for some time now to evaluate support resource requirements which meet readiness goals. In the case of the F/A-18, McDonnell Douglas initially used two simulation models to evaluate the influence of more than 350 repairable aircraft components on operational readiness. Unfortunately, the models were expensive to run, entailed time-consuming preparation of input data, and provided poor visibility of the effects of individual components.

To solve these problems, logistics engineers at the company developed a new support evaluation model, the logistic element alternatives process. Unlike more elaborate approaches, this tool simplifies the many factors comprising aircraft component support into just a few key logistic elements. Using it, logisticians can predict potential support deficiencies, identify spares cost-reduction opportunities, and formulate corrective actions to achieve readiness goals at less cost. Spares cost avoidance on the Hornet, for example, has amounted to more than $14 million to date.

Initial supportability study

Early on, the Navy recognized the need to anticipate and react to potential F/A-18 support problems before those problems had an adverse impact on readiness. The service therefore asked McDonnell Aircraft Company to initiate a supportability study one year before delivery of the first production aircraft. The purpose of the study, known as the supportability assurance readiness program, was to evaluate planned levels of logistic support and recommend changes to achieve F/A-18 readiness objectives. The study group carried out this analysis for more than 350 F/A-18 repairable components.

To evaluate F/A-18 support levels, the group first used two random-event simulation models, the logistics composite model and the comprehensive aircraft support effectiveness evaluation model. These sophisticated mathematical constructs simulate the organizational-level maintenance activity and associated repair processes. The

The support process for Navy aircraft comprises three levels of maintenance: organizational (flight line), intermediate (on-site shop), and depot (remote repair facilities). At the organizational level, mechanics repair aircraft, sometimes removing and replacing components, called weapon replaceable assemblies, which have been diagnosed as failed; the time between removals is known as mean time between demand. Next, as dictated by established maintenance policy, the components go to either the intermediate or depot repair levels and, following repair, to local supply, where they are reissued. The total time from removal through repair and transportation back to local supply is turnaround time.

Planned turnaround time is usually seven days at the intermediate level and 90 days at the depot level; the Navy procures spares in sufficient quantity to replace weapon replaceable assemblies during the expected turnaround times. In the case of the F/A-18, the schedule called for phasing in repair capability at the intermediate level for many components during the first few years of the program. McDonnell Douglas and its equipment supplier group recognized the need for a new support evaluation tool.

To meet the objectives of the supportability assurance readiness program, the new evaluation tool had to have three characteristics:

- Unlike the logistics composite and comprehensive aircraft support effectiveness evaluation models, which are ideally suited to aggregate the interaction of all weapon system components, it needed to be sensitive to the effects of one component. That capability would allow logistics engineers to evaluate the support process for each component individually. After determining required support levels for individual components, they could use the large-scale simulation models to assess the resulting impact of all components on aircraft readiness.
- The new model had to be responsive to the concerns of engineering and logistics managers. They typically ask questions such as: What effect do delays in intermediate-level repair capability have on operational readiness? If repair turnaround times are longer than planned for a given component, what is the impact on readiness? What happens when a spare parts supplier cannot meet his delivery schedule or funds are not available to buy required quantities of spares? Should a supplier put his assets into more repair facilities in order to reduce repair turnaround times or into more production facilities in order to speed up delivery of spares?

during the first few years of a weapon system than at any other time because the rapid build-up of aircraft requires a corresponding increase in logistic support resources—spare parts, support equipment, manpower, and the like. On the F/A-18 program, for instance, aircraft inventory levels more than doubled in each of the first three years following initial fleet introduction. A change in requirements for any one support resource during rapid build-up can seriously impair operational readiness until adjustments can be made.

For example, demand for spare parts may be greater than expected. To cope with this situation (once identified), managers can bolster logistic resources under their control. Designers can implement design changes to improve reliability or maintainability; spares provisioning managers can buy more spares or accelerate their delivery; and managers of supplier repair programs can buy more repair equipment or add manpower to reduce repair turnaround times. But in the absence of information about key logistic resource interactions, the most cost-effective support decisions during the first years of a weapon system can be very difficult.

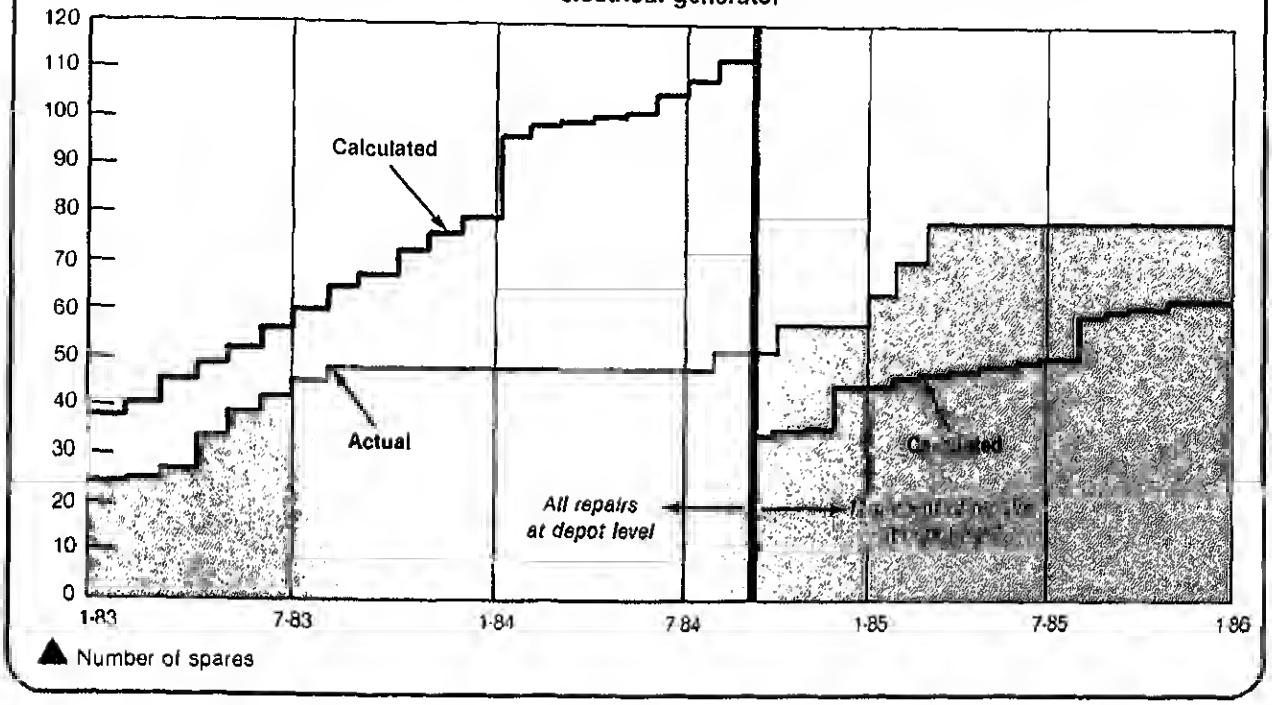
ployed the latter in evaluating carrier-based operations.

During initial attempts to evaluate the Hornet's component logistic support levels with the aid of these models, several difficulties arose. One resulted from the inherent complexity of the models, which require 26,900 elements of input data on the F/A-18 in order to describe the aircraft's flight-line activities and maintenance characteristics. Obtaining these data and processing them into acceptable formats took many months. Further, evaluation of one data element variation cost $50–$100, and simulations were required for hundreds of data variations. The large costs resulted from the quantity of data processed and the number of maintenance and operational activities simulated.

A new analysis tool needed

What's more, neither model proved a particularly effective tool for evaluating logistic support requirements at the component level. When the study group evaluated alternate levels of logistic support—for example, improved reliability, shorter turnaround times, and more spare parts—for individual components, they found that the resulting changes in aircraft readiness were usually insignificant and not traceable to a specific component. Because the two models were of little use in relating variations in individual component support levels to readiness, the

Figure 1. Spares required to reach an 80-percent spares protection level for the F/A-18's electrical generator



• The model had to employ just a few key elements to represent the many logistics issues simulated. This feature would allow users to assemble data and perform analyses quickly and inexpensively (less than $10 per model run). However, the new tool also had to preserve interaction of the key elements that characterized the large-scale simulation models.

Key elements of logistics issues

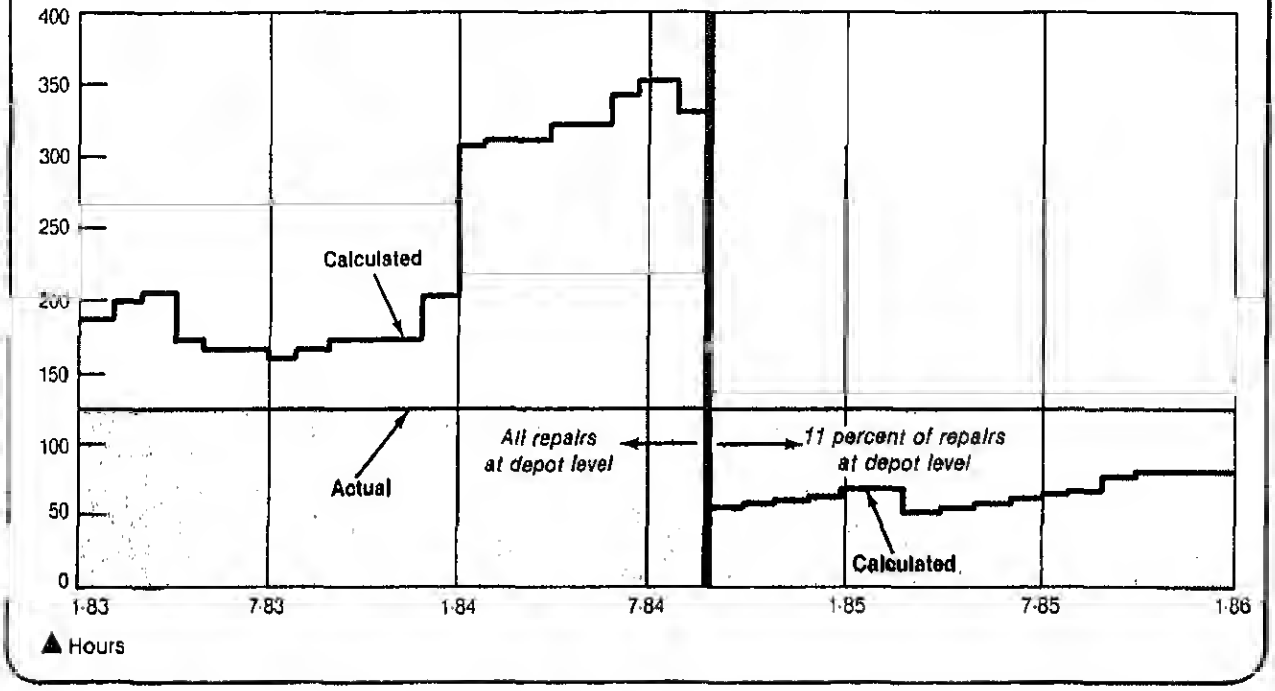
The supportability study group categorized the logistics issues to be addressed under four key elements, and the interaction between the four formed the basis for the new analysis tool. Issues subsumed under the first element, *mean time between demands*, included inherent reliability and the performance of built-in-test and fault diagnostic equipment; *turnaround time*, the second element, comprised repair and transportation times as well as administrative delays and related matters involving adequacy of the test equipment; budget constraints and lead times came under the third element, *spare parts procurement*; and the fourth one, *beyond capability of maintenance*, covered planned level of repair and also delivery schedules for support equipment, training, and technical publications. To

The spares protection level expresses quantitatively the probability that a spare part will be available when needed. Specifically, it indicates the degree to which a given quantity of spares is adequate to offset the combined effect of mean time between demand, turnaround time, and components designated beyond capability of maintenance. If one of these last three logistic elements changes from initial estimates—if reliability is less than planned, for example, resulting in lower mean time between demand—then the spares protection level will show the degree of support system imbalance.

To put it another way, the spares protection level represents the probability that the demand for replacement spares during repair turnaround time will be equal to or less than the number of spares actually procured. The equation assumes that the random occurrence of demands follows a Poisson probability distribution. The variable for the spares demand rate in this equation is directly proportional to aircraft quantity, flying hours, and repair turnaround time; it is inversely proportional to the mean time between demand.

The following example will help clarify these relationships. Assume 100 aircraft, each of which flies one hour per day; mean time between demand is 1,000 hours, and

Figure 2. Mean time between demand necessary to meet an 80-percent spares protection level for the F/A-18's electrical generator



first multiply the number of aircraft by the daily flying time and then divide the product by the mean time between demand; multiply the result (0.1) by the number of days of turnaround time. The spares protection level for various spares quantities in this hypothetical example would be as follows: no spares, 5 percent protection; one spare, 20 percent protection; two spares, 42 percent; three spares, 65 percent; four spares, 82 percent; and five spares, 99 percent.

As the protection level approaches 100 percent, whether due to more spares, an increase in mean time between demand, or decreased turnaround time, the level reaches an optimum point representing the most cost-effective mix of support resources. Thus, as the example illustrates, the key logistic elements—mean time between demand, turnaround time, and beyond capability of maintenance—determine the spare parts demand rate, which, in conjunction with spares quantity, determines the spares protection level. A weapon system can achieve high levels of operational readiness so long as the combination of these elements results in a sufficiently high spares protection level.

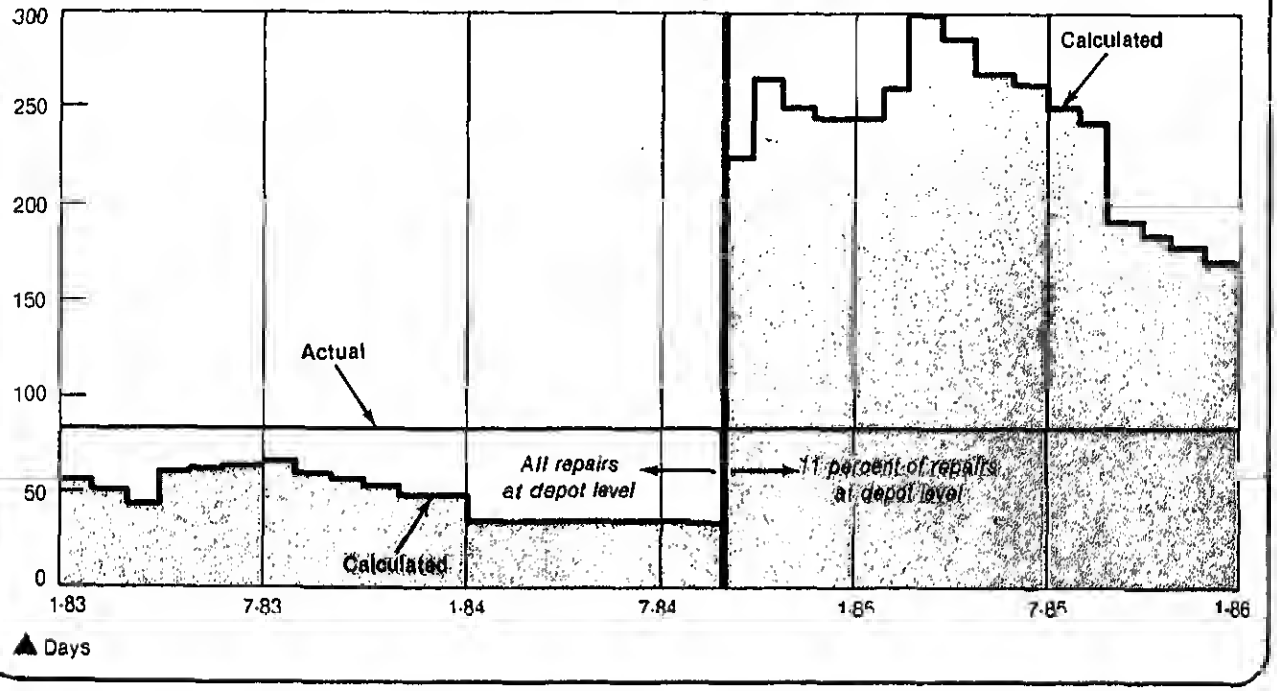
Application of the technique

matically modeled the relationships described above. The group then used the model to evaluate component support at the start of F/A-18 operations. Analysts supplemented mean time between demand predictions with actual field data provided by reliability and maintainability engineers; they derived turnaround time data from contractor and Navy depot repair experience. Supply support analysts provided information on initial spares quantities based on planned and actual delivery schedules for the period from 1983 through 1985.

These data provided a basis for forecasting spares protection levels for approximately 350 maintenance-significant weapon replaceable assemblies on the F/A-18. Rank ordering the components by spares protection level revealed that approximately 50 assemblies had protection levels near zero. At the opposite end of the ranking, several weapon replaceable assemblies showed large quantities of procured spares exceeding levels required, and the group evaluated those for cost-saving opportunities.

In analyzing support requirements for components that had low spares protection levels, McDonnell Douglas, following Navy ground rules, set the baseline protection level at 80 percent. Historically, an 80-percent spares protection level has met Navy operational readiness goals at an affordable cost. Given this level, the study group solved the

Figure 3. Depot-level turnaround time needed to achieve an 80-percent spares protection level for the F/A-18's electrical generator



beyond capability of maintenance. In doing so, the analysts were able to determine required compensating levels for components that fell short of the 80-percent benchmark. These analyses in effect constituted early warnings that enabled managers of each logistic element to take steps to head off predicted support deficiencies. In some cases, they accelerated delivery of spares or support equipment; in others, they improved reliability or reduced repair turnaround times.

An F/A-18 case study

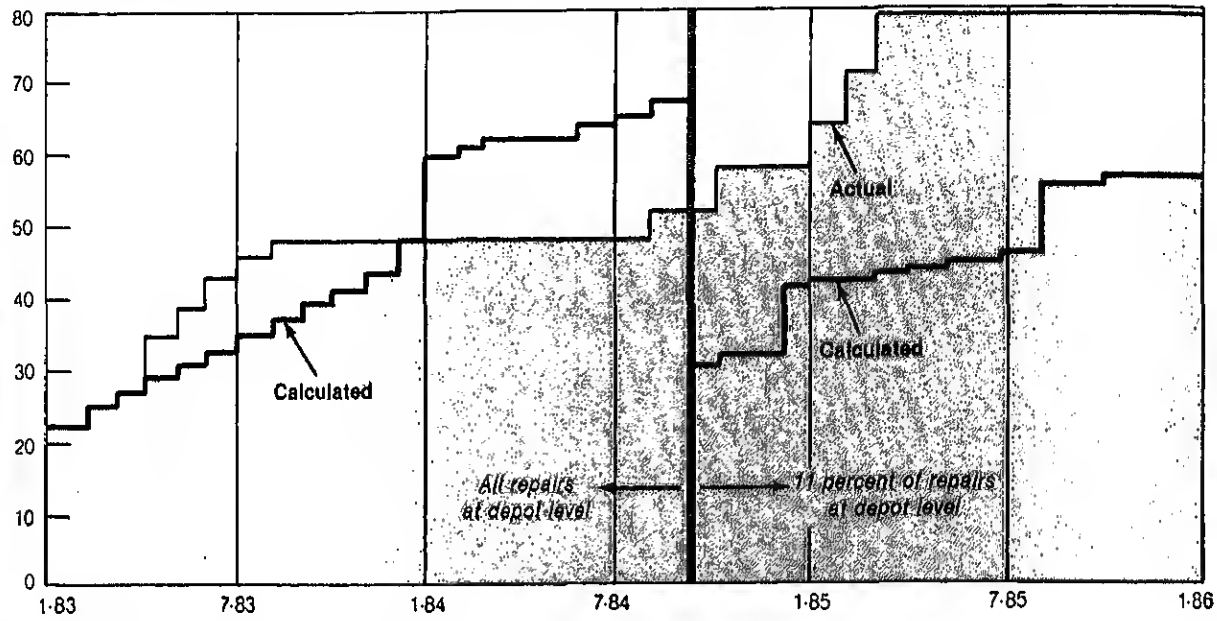
An actual application of the model will help illustrate the benefits of the logistic element alternatives process more fully. Logistics managers at McDonnell Douglas used the process to analyze the Hornet's electrical generator, a mission-critical component. The ground rules were as follows:

- Aircraft quantity would build up from 50 in January 1983 to 211 in December 1985.
- Spares would be available in the procurement quantity specified in the supplier delivery schedule.
- Aircraft utilization would be 30 flight hours per month per aircraft.
- Turnaround time was to be 85 days for depot-level repair and seven days for intermediate-level repair.
- Mean time between demand was to be 120 hours.

F/A-18 program planning required that the supplier repair the item, that is, provide depot-level repair, until intermediate-level repair capability became available in September 1984. Therefore, the generator was 100 percent beyond capability of maintenance until that time, after which, plans called for return of only 11 percent of the units to the depot for repair. The mean time between demand of 120 hours reflected actual field experience to date. Logistics engineers followed these ground rules in solving the support element equations prescribed by the model.

Figure 1 (p. 35) shows the quantity of spares required to balance the support system, that is, to achieve an 80-percent spares protection level, and also indicates the actual spares delivery schedule. The shaded area between the two lines represents a predicted spares shortage. The growing aircraft inventory resulted in an increasing spares shortage until September 1984, after which the reduction in turnaround time—seven days at the intermediate level compared to 85 days at the depot level—would produce a safety cushion of spares. Additional procurement of spares

Figura 4. The affact on tha support system of tha Naval Air Rawork Facility's 30-day turnaround tima when combined with tha supplier's 60-day turnaround time



Evalnation of mean time between demand produced the results displayed in Figure 2 (p. 36), which represents mean times necessary to achieve an 80-percent spares proteetion level. As in Figure 1, the shaded area indieates a likely support shortfall. To adequately compensate for that deficiency and maintain the 80-percent spares protection level, mean time between demand in 1984 would have had to exceed 300 hours, as shown. At the time of the analysis, engineers had identified no near-term design change to improve the component's reliability. Thus, the evaluation for this element did not reveal a support alternative available in the near future.

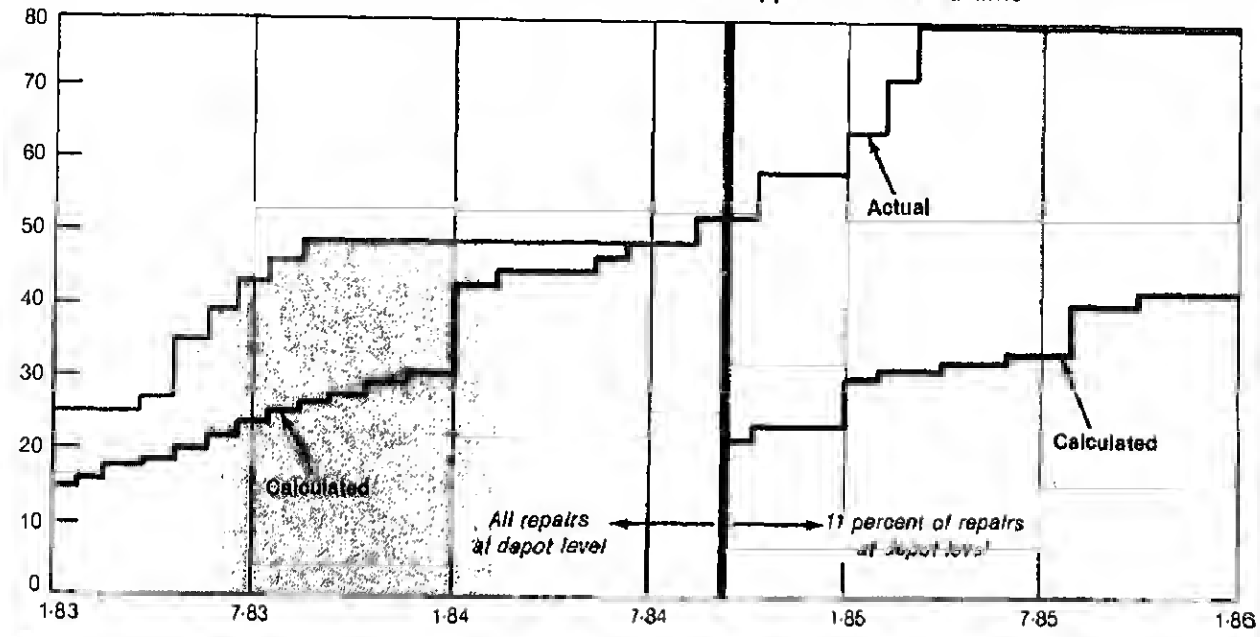
Analysis of repair turnaround time yielded the data depicted in Figure 3 (p. 37). Because plans called for repair of only 11 percent of the generators at depot level after September 1984, existing spares quantities would have justified a tenfold increase in depot-level turnaround time—300 versus 30 days—toward the end of 1984. However, the findings pointed to a support problem prior to September 1984 due to the difference between planned depot-level turnaround time—85 days—and that needed to meet the spares protection level—30 days. Having been alerted to this likely support deficiency, the company's repair program managers were ahle to reduce the depot-level turnaround time to 60 days by expediting transportation of 60-day repair turnaround time did contribute to a partial solution of the predicted support deficiency.

Other applications

In addition to its usefulness in evaluating the logistics alternatives just described, the logistic element alternatives process proved valuable in analyzing other logistics resources as well. In late 1982, for example, the company learned that a new facility might be available to assist the supplier in repairing electrical generators for the aircraft. The Naval Air Rework Facility, a Navy depot, was proposing that it repair 50 percent of the faulty components in a 30-day turnaround time. With the aid of the newly developed model, the supportability study group was able to assess the merits of this proposal quickly. Specifically, the group looked at the effect of the rework facility's 30-day turnaround time when combined with a 60-day supplier turnaround time. As Figure 4 shows, the model predicted an adequate quantity of spares for 1983 rather than a shortage. This analysis convinced Hornet program management that the proposal, in conjunction with a 60-day supplier turnaround time, would prevent the anticipated support deficiency.

The methodology provided by the logistic element alter-

Figure 5. The combined effect on the support system of the improved meen time between demand, repeir by the rework facility, and shorter supplier turnaround time



Hornet. It also helped them evaluate a combination of logistics alternatives—reduced turnaround time plus additional repair facilities—that offered both near- and long-term solutions. Though capable of simulating interaction among several hundred components at one time, neither the logistics composite model nor the comprehensive aircraft support effectiveness evaluation model were useful in pinpointing alternate solutions.

The newly developed model played a role in company efforts to analyze the effect of improved generator reliability too. Reliability, maintainability, and quality engineers at McDonnell Douglas evaluated the electrical generator's reliability performance in 1983 and concluded that an excessive number of generator subcomponents had failed prematurely. After studying the process used to manufacture the component, management determined that many of these failures were attributable to poor quality control and therefore persuaded the manufacturer to implement improved quality control procedures. Thanks to these measures, field reliability data in late 1983 indicated that mean time between demand had improved to 170 hours.

Using the logistic element alternatives process, the company evaluated the combined effect of the improved mean time between demand and the other two logistic alternatives—repair by the Naval Air Rework Facility and

mand of 170 hours, the spares shortages predicted for 1984 were no longer a problem. By adjusting various logistic elements—mean time between demand, turnaround time, and beyond capability of maintenance—management was able to head off a potential support system imbalance. Failure to identify and act upon these adjustments in a timely manner could have seriously degraded aircraft operational readiness due to the unavailability of spare generators.

A major advantage of the logistic element alternatives process technique is timeliness of the analysis. A typical iteration, including data acquisition, takes a matter of days, compared to months for large-scale simulation models. Quick response time can be extremely critical, especially during the first years of a weapon system's service. During this period, with an extremely small operational base to draw on, major changes in component reliability and maintainability performance can occur rapidly and can have major logistic consequences. The quantity of spares required, for example, is extremely sensitive to variations in mean time between demand and turnaround time (see Figure 6, p. 40); under such circumstances, timely logistic support analysis is critical.

Equally important is the accuracy of support system and component reliability and maintainability based on field

quently, a dedicated field data collection and analysis effort is essential if the model is to yield valid support evaluation predictions.

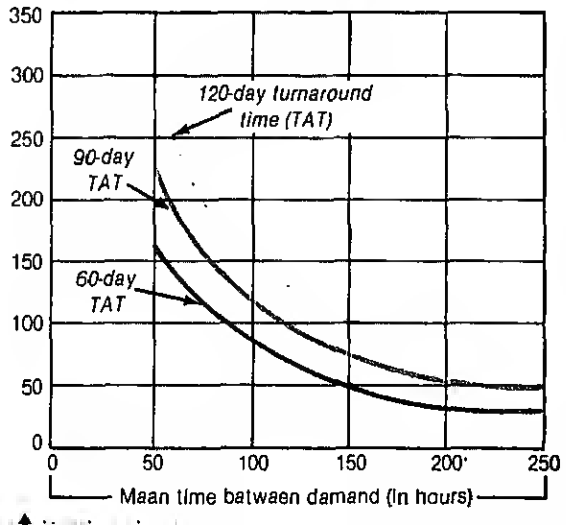
Additional uses

Experience with the F/A-18's electric generator illustrated the uses of the model in evaluating requirements for undersupported components. The logistic element alternatives process can also be of value in analyzing oversupported components, those that have spares protection levels near 100 percent. For example, when McDonnell Douglas applied the technique to approximately 50 weapon replaceable assemblies which had protection levels approaching 100 percent, management found that the quantity of spares required was much lower than the quantity procured, largely due to improvements in mean time between demand after spares orders had been placed. In light of these results, Navy provisioning personnel reevaluated component demand rates and were able to confirm the support imbalances revealed by the simulation. Early identification of spares cost-reduction opportunities enabled the service to reduce spares orders for at least seven of the 50 weapon replaceable assemblies and to avoid costs of approximately $14 million. Since then, Navy officials have been able to realize additional spares cost reductions.

Successful application of the logistic element alternatives process to the F/A-18 program holds a number of valuable lessons. It demonstrates that the many factors which affect weapon system support can be reduced to a few key logistic elements. The interaction among those elements, expressed as the spares protection level described above, allows logistics engineers to predict support deficiencies and identify spares cost-reduction opportunities. By using the technique to compare logistics alternatives, engineering and logistics managers can better coordinate their efforts and make more cost-effective support decisions. DMJ

> The supportability study group categorized the logistics issues to be addressed under four key elements: mean time between demands, turnaround time, spare parts procurement, and beyond capability of maintenance.

Figure 6. Sensitivity of required spares to variations in mean time between demand and turnaround time



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An interim report to the president by the president's blue-ribbon commission on defense management, February 28, 1986

Last July, President Reagan appointed a 16-member commission to examine today's most pressing defense management issues. Headed by former deputy secretary of defense David Packard, the blue-ribbon panel recently issued a summary of its major findings and recommendations. The interim report addresses four key management areas. A synopsis of the commission's conclusions in each of these areas follows.

National security planning and budgeting

The nation's political and military leaders must more thoroughly evaluate and then synthesize national security objectives, and they must accurately assess the funding necessary for achieving them. This process requires long-range planning based on fiscally constrained and fully integrated military advice. The current absence of such a planning system leads to instability and uncertainty in defense management.

Effective planning demands that DoD focus more tightly on major missions when it presents its budget to Congress. By doing so, the department will promote more efficient congressional budget reviews. To the detriment of key strategic matters and operational concepts, these reviews now tend to dwell either on gross dollar allocations or the minutiae of line items.

The practice of annual budgeting is also a problem in this area, one that contributes to DoD's historical penchant for "management by hits and starts." A shift to biennial budgeting, coupled with the authorization and appropriation of major programs only at key milestones (rather than annually), is an important prerequisite to a solution. In addition, improved defense planning presupposes the existence of the comprehensive statement of national security objectives referred to above. Such a statement, reflecting the recommendations of the National Security Council, can serve as a starting point for planners.

At the outset of his administration and as required thereafter, the president should issue provisional five-year DoD funding levels based on these same objectives. Then, at the direction of the secretary of defense, the chairman of the joint chiefs of staff should formulate a military strategy for achieving national security goals within presidentially defined budget levels.

Military organization and command

Advice given to the president and secretary of defense must better integrate the views of the combatant commanders and the service chiefs. Currently, no single uniformed officer is clearly responsible for providing such an integrated view. The authority of the chairman of the joint chiefs of staff is insufficient to enable him to do this effectively.

Legislation should be enacted designating the chairman of the joint chiefs, representing his own views as well as the corporate views of the other joint chiefs, as

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dicating that the disclosure was a significant factor in the reassignment of the employee. Therefore, in the eyes of the board, the reassignment action constituted an act of reprisal.

In another case, the Merit Systems Protection Board demoted the chief of police at the Veterans Administration Medical Center in Palo Alto-Menlo Park, California, for taking action against a subordinate who had disclosed managerial improprieties to the Veterans Administration inspector general and to a newspaper reporter. The employee had revealed that members of the police force were being assigned a great many nonpolice duties and that police officers were inadequately equipped, each having received only a can of mace as a self-defense weapon. Shortly thereafter, the chief reassigned the whistleblower, reduced from 15 to two the number of employees he did not qualify for protection because the employee had made it in "an entirely misleading manner." Rejecting that defense, the Merit Systems Protection Board stated that an employee, in order to be protected from reprisal, needs only to prove that he or she reasonably believed that the reported condition constituted mismanagement, not that it actually did.

In yet another case, the board reduced the Department of Energy's assistant inspector general from a Senior Executive Service position to a GS-14 for retaliating against a subordinate who had drafted correspondence critical of the inspector general's office. The supervisor geographically reassigned the worker, who had written, but never mailed, a letter citing mismanagement and abuse of authority in a reorganization of the office. The intended recipient was a congressional investigator.

The assistant inspector general claimed that the allegations contained in the letter policy and objectives. Thus, according to the supervisor, the reassignment was simply a management expedient and not reprisal. He also contended that an unsent letter created no negative consequences and therefore could hardly be viewed as having furnished cause for retaliation. The board rejected this line of defense and concluded that the subordinate's cross-country reassignment from Washington, D.C., to Albuquerque, New Mexico, was an act of retribution that violated the spirit of the 1978 reform act.

The creation of the Office of Special Counsel marks the first time Congress has chartered an independent prosecutor to protect federal employees from reprisals for blowing the whistle on government fraud, waste, abuse, and mismanagement. With its broad power and authority to investigate allegations of prohibited personnel practices and to prosecute those responsible, the Office of Special Counsel is an important and

the principal uniformed military advisor to the president, the National Security Council, and the secretary of defense. Also, the views of the combatant commanders need stronger, more purposeful representation within the councils of the joint chiefs and during weapon requirements decision-making.

The report noted that, as the sixth member of that group, the four-star vice-chairman would assist the chairman measurably by representing the interests of the combatant commanders, and co-chairing the Joint Requirements Management Board, while performing other duties as prescribed by the chairman.

Improvements are likewise needed in the several unified and specified commands into which combat forces are organized. The measure of command now accorded the combatant commanders is not always sufficient to ensure the successful, cohesive performance of U.S. forces. If they are to fully meet their mission responsibilities, the unified commanders must have authority that goes beyond operational command.

An outgrowth of World War II philosophies, today's command structure is designed to deal with high-intensity conflict across vast global regions. While it may be appropriate for general war, that structure is not always well-suited to the regional crises and conflicts that are more common today. The Unified Command Plan should therefore be revised to ensure the increased flexibility needed in dealing with situations that overlap the geographic boundaries of the current combatant commands.

Acquisition organization and procedures

Although DoD already has realized significant savings through improved procurement techniques, the executive and legislative branches can do more to increase the stability of national security planning and budgeting and thereby reap additional rewards. Current program and funding instabilities thwart economies of scale, lead to program stretchouts, and deter contractors from making long-term capital investments.

Responsibility for acquisition policy, for instance, is fragmented. No single DoD senior official provides overall supervision of the acquisition system; a new position, under secretary of defense (acquisition), is in order. The incumbent would set policy for procurement and research and development, oversee the entire acquisition system, and exercise responsibility for monitoring the administration and auditing of contractors.

Additionally, acquisition managers need to do a better job of determining requirements and estimating costs at the outset of systems development. A larger investment of money and engineering at the front end of the cycle would result in timely fielding of more reliable and effective systems. Project managers should fully test system and subsystem prototypes before advancing programs to full-scale development. The early phases of research and development should employ extensive informal competition and streamlined procurement processes. Moreover, they should demonstrate that the technology being tested can significantly improve military capability.

All too often, requirements for new weapon systems are overstated, leading to unnecessarily lengthy, complex, and cost-driving specifications. Rather than impose excessively rigid military specifications, DoD should make greater use of off-the-shelf components, systems, and services. The department should develop custom-made items only when commercially available items are clearly inadequate to satisfy military requirements.

Other changes are needed in federal law and DoD regulations to better promote commercial-style competition that emphasizes quality, established performance, and price. This is particularly true in the areas of research and development and professional services. In a related vein, DoD and Congress should expand use of multiyear procurement for high-priority systems, a move that would lead to increased program stability and lower unit prices.

Government-industry accountability

Cooperation between government and industry is essential if private enterprise is to fulfill its role in the defense acquisition process. However, questionable practices that undercut public confidence in the defense contracting process jeopardize this partnership and should be eliminated.

For example, aggressive and sustained enforcement of civil and criminal laws is necessary to deter misconduct and safeguard the reputation of contractors who operate lawfully and ethically. But authorities could strengthen enforcement by amending the civil False Claims Act and providing for the administrative adjudication of small false-claims cases.

Moreover, to ensure that their practices comply with law, defense contractors should vigorously and vigilantly enforce codes of ethics that address the unique problems associated with military procurement. They must also develop and implement internal controls to monitor adherence to these principles and assure contract compliance. Contractors should go even further and recognize their legal and moral obligation to alert government officials to misconduct uncovered through self-review. By the same token, DoD must ensure that its military and civilian personnel comply with the same high standards expected of contractor employees.

Defense agencies and Congress need to improve and coordinate their oversight of contractor operations too. They should formulate guidelines that will reduce duplication of effort and better enable audit agencies to share contractor data.

But the services and the Defense Logistics Agency should suspend or debar a firm only to protect the public interest, that is, when a contractor lacks "present responsibility" to do business with the government. They should not do so solely as a response to an indictment or conviction predicated on former conduct. The Federal Acquisition Regulations must therefore precisely describe the conditions under which punitive action is appropriate and establish criteria that managers can use for determining whether a contractor lacks present responsibility. Additionally, the secretary of defense should issue policy guidance that ensures uniform administration of suspensions and debarments.

The commission will release a detailed report on its findings and conclusions in June 1986.

news summary

DoD sets mark for small business awards

Small business firms received a record-high $26 billion in prime contracts during fiscal year 1985. This figure exceeds the preceding year's total by $2.2 billion and represents nearly one-fifth of DoD prime contract expenditures for the period.

Small firms also received $20.1 billion in subcontracts, 18 percent more than in FY 1984, and small disadvantaged and women-owned firms realized contract dollar gains of 9 percent and 25 percent, respectively.

Since its inception in 1953, DoD's small business program has sought to expand contracting opportunities for small companies and thereby broaden the defense industrial base. (OASD(PA) news release: February 5, 1986)

Survey cites pay gains for middle managers

According to the Administrative Management Society of Willow Grove, Pennsylvania, middle-management salaries in the private sector increased 6 percent during 1985. That figure is based on results of a recently completed survey of more than 30,000 middle managers in some 2,300 North American companies.

Plant managers and sales managers earned the highest mid-level management salaries last year and also received relatively large pay increases of 8.6 percent and 8.3 percent, respectively. Only employment managers, whose average salary after a 4.9-percent pay raise was $25,700, or about $8,500 below the sample average.

American firms budgeted an average merit increase of 5.6 percent in 1985 and are planning 5.5 percent in 1986. (Administrative Management Society news release: January 1986)

European allies warming to simulation devices

European armed forces are expected to spend $1.9 billion on military training aids and simulators between now and 1990. The substantial interest indicated by such outlays is linked to recent simulation advances which enable students to acquire bona fide job-related and combat skills, not simply a prowess in video games.

Market analysts cite other factors for the enthusiasm, pointing out that today's devices offer safety and economy and require less space than actual systems.

European air forces are projected to make 37.5 percent of the purchases during the period, while land and sea elements will account for 34.5 percent and 28 percent, respectively. West Germany is expected to top the list of buyers, followed by Great Britain, France, Spain, and the Netherlands. (Frost & Sullivan, Inc., news release)

More leeway given to installation commanders

Deputy Secretary of Defense William H. Taft IV has ordered broader flexibility in managing their activities.

The plan calls for extending authority and responsibility under the program to lower organizational levels, fostering more competition within local economies, and providing more effective incentives for reducing base-operations costs.

Despite the general success of the original program, many local commanders have stated that an inordinate number of regulations prevent them from running their bases at optimum efficiency and getting the most value out of every dollar spent. The revision is designed to eliminate those impediments and grant local commanders and managers greater discretion in managing base operations. (OASD(PA) news release: February 27, 1986)

Air Force contracts for technical support

In an effort to combat projected staffing shortfalls and augment in-house proficiencies in critical skill areas, the U.S. Air Force Armament Division, Eglin AFB, Florida, has awarded a three-year, $60 million engineering services contract to Svordrup Technology, Inc.

Under the agreement, the Norwegian firm will provide technical and engineering expertise in support of Air Force weapon system project management. The technical and engineering acquisition support program is intended to improve continuity in acquisition management and ensure ready availability of the many high-soon-to-be-completed facility on the base. (USAF Armament Division news release: January 24, 1986)

Navy joins test of flat-rate per diem

The Navy is the latest participant in a flat-rate per diem test program designed to expedite temporary duty payments and reduce travel-related paperwork. The Air Force, Defense Logistics Agency, and Coast Guard have been testing the concept for more than a year.

Through the end of fiscal year 1986, Navy personnel whose pay records are maintained in one of five selected locations will receive a flat-rate amount ranging from $50 to $75 for each day of stateside temporary duty. The locations are Washington, D.C.; Great Lakes, Illinois; Puget Sound, Washington; Pensacola, Florida; and Hawaii.

According to program officials, the per diem amount can be considerably larger for overseas temporary duty assignments. They also point out that amounts will vary depending on the availability of government accommodations. Although test participants are not required to keep lodging and meal receipts, they still must be prepared to submit vouchers verifying the nonavailability of government lodging and meals.

The Navy Accounting and Finance Center will analyze the test results this fall and make recommendations regarding Navy-wide adoption of the concept. The Marine Corps is not

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